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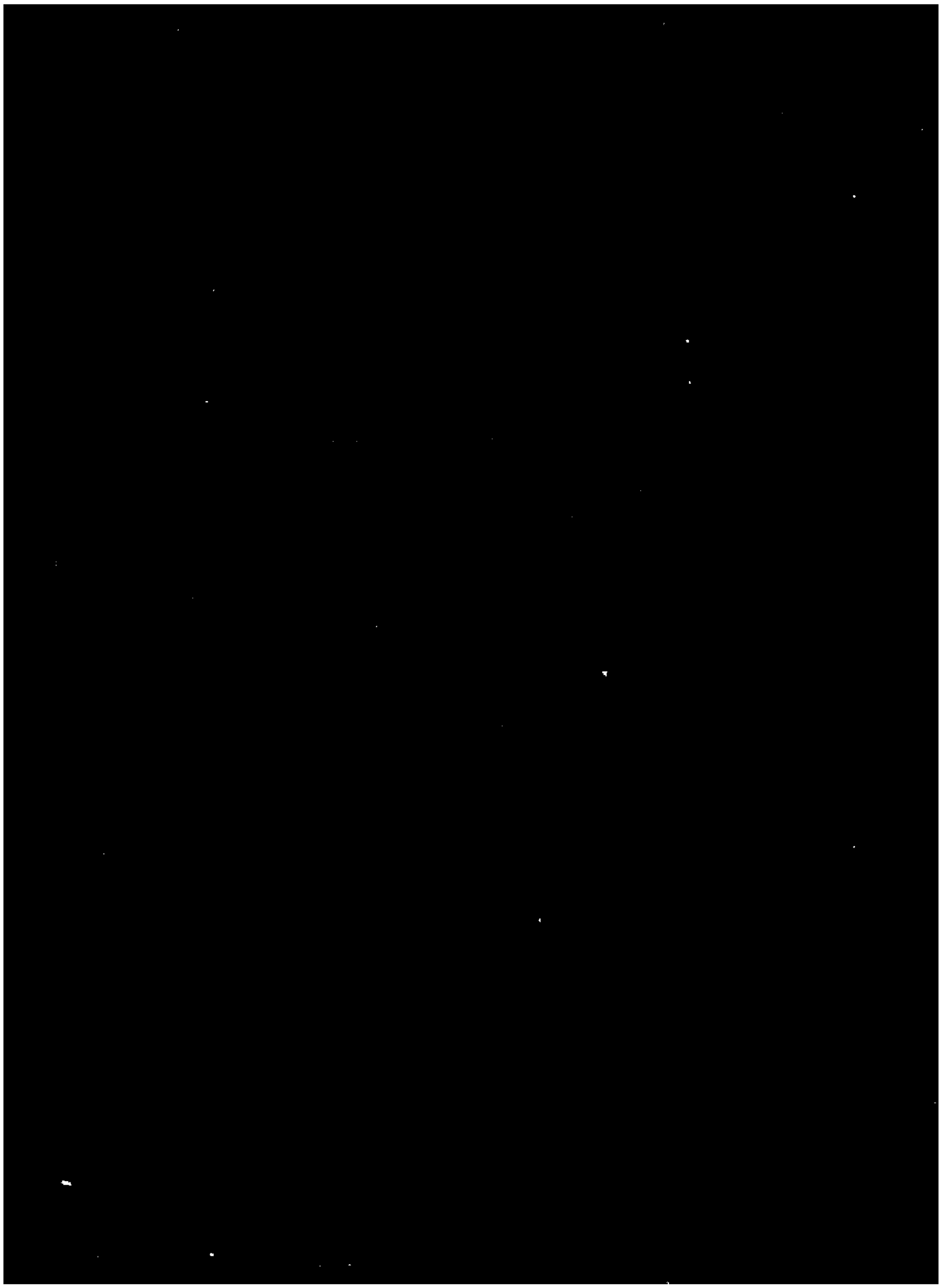

SVIC NOTES

This past April, I had the privilege of participating in an Engineering Foundation Conference on "National Technological Cooperation." The conference involved some sixty representatives of government, industry and academia brought together for the purpose of developing an effective technology diffusion system. Such a system would enhance broader application of existing and newly-developed technology and lead to greater industrial innovation and increased national productivity. The problems of designing a technology delivery system are complex, involving a number of factors other than information transfer. No specific technology diffusion system was proposed as a result of the conference. Rather it was concluded, among other things, that there exists in the United States a technology system with interactive and interdependent components. It is to some specifics relating to this conclusion that I wish to address the remainder of this column.

During the conference there was considerable emphasis on better utilization of resources by means of faster contacts between resources and users through data banks, referral systems and information centers. Furthermore, a technique variously described as "information packaging" or "adaptive engineering" was considered as extremely important in the effective application of technical information. There is a perceived need for technology developed for a given purpose to be repackaged or adapted for another use. Finally, the importance of person-to-person linkage through "transfer agents" or "gatekeepers" was stressed; it was viewed as a technology-transfer mechanism that was worthy of further development and greater utilization. This is the "on-line" transfer of technical information that I have written about previously.

The concept of an information analysis center (IAC) provides a mechanism for all the requirements set forth in the preceeding paragraph. By definition, an IAC is a center of expertise for a specific technological area and therefore should be able to provide timely contact between resource and user. The discipline-oriented IAC has interests that cross over project or product lines. It should be aware of different applications of the same technology and be able to assess the potential for new applications of that technology. The method of operation of the IAC emphasizes a "one on one" transfer of technical information. The scientists and engineers on the IAC staff could logically become the "transfer agents" that were mentioned earlier. Why, then, are things not working as they should?

Both the existing information resources and the links to those resources are fragmented. There are a number of systems in place that often serve only a specific community of users or, at best, provide services within the broad research and development community. There are few existing systems that are capable of serving up technology in a way that is directly applicable to the development of new products and processes in industry. Furthermore, even if we consider the IACs to be the most effective links in a technology delivery system, there are not enough IACs in being to cover our broad technology base. In spite of these difficulties, I feel that our best course of action is to look to what we have. We must provide the missing links and pieces to make the existing systems work, rather than to propose yet another complex technology transfer system to add to the confusion.

H.C.P

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EDITORS RATTLE SPACE

ETHICAL PUBLICATION PRACTICES

Last month I wrote about the publication explosion, the fate of technical publications, and the publication process. In my opinion, the literature explosion is not the result of an abundance of newly developed, high-quality data, techniques, case histories, or equipment; rather, the proliferation of articles is due to publication of similar work more than one time -- often in different form. Repeated publication of the same basic information creates problems with cost, storage, availability, and location of technical literature. And everyone involved in the publication process -- societies, publishers, authors, and their employers -- must share responsibility for creating these problems. The ceaseless quest by societies and publishers to fill existing journals so that they can create new ones is one factor contributing to republication of existing technology. In addition, individuals are often rewarded by the institutions or corporations that employ them on the basis of number of papers published per year.

Some of the practices followed by authors today are unethical. Many times during my 12 years as editor of the DIGEST, I have seen the same articles published in more than one journal. Most of the articles have not been revised; however, revisions also contribute to the duplication of literature; my educated guess is that only 50 percent of today's literature is original. In my opinion, literature should be condensed and articles on similar subjects should be published in pamphlet and book form.

Republication of technology developed during government-sponsored projects is another major source of republished literature. Most research and development reports are documented in formal government reports that are readily available as open literature. Why then should this work be republished in technical journals? The ASME JOURNAL OF FLUID ENGINEERING has proposed that only summaries of government reports -- giving major findings -- should be published. This approach would alleviate the republication situation.

It is the responsibility of engineers to curtail the multiple publication of research and development results. The continued reworking and republication of existing material has made it difficult for everyone concerned with the publication process as well as those who must utilize new technology.

R.L.E.

STABILITY PROBLEMS OF ROTOR SYSTEMS

T. Iwatsubo*

Abstract *- This article is a review of the literature published in 1978 and 1979 on instability in rotor systems. Included are instability due to internal damping, dry friction, bearing forces, fluid forces, parametric excitation, torsional and torsional lateral vibrations, and asymmetric elements.*

This review article is concerned with the literature of instability problems in rotating machinery. The following causes of instability are included: internal damping, dry friction, bearing forces, fluid forces, parametric excitation, torsional and torsional-lateral vibrations, and asymmetric elements.

INTERNAL DAMPING

The effect of internal and external damping on the divergence and flutter boundaries of rotating systems has been studied [1]. The stability of a rotor subjected to hysteretic forces and externally damped only through the shaft support has also been studied [2]; the stabilizing capacity of bearings against hysteresis damping was obtained [2]. The self-induced vibration due to internal damping that can occur when a rotor is passing through its critical speed has been studied by Nonami and Miyashita [3].

DRY FRICTION

Rubbing contact between a rotor and its housing results in localized heating of the shaft, which bows due to thermal expansion. The thermal bow gradually changes in magnitude and position relative to the shaft because of the phase lag between the deflection and bending forces of the shaft. The total bowing at constant speed can be represented by a time-dependent vibration vector, or point vector, which describes a spiral whose amplitude increases infinitely; the problem has been studied by Kellenberger [4]. Conversely, rubbing contact between a rotor and its housing induces a restoring force that can lead to parametric excitation or half-speed whirl at the natural frequencies of the rotor. This problem has been investigated as a parametric excitation problem [5]. Resonances of 1/2, 1/3,... were obtained using Hsu's method.

BEARING FORCES

Journal bearings. Both the theoretical and experimental characteristics of journal bearings are known, so that coefficients of bearing forces can be calculated with accuracy. Current problems include stability analysis of rotor systems supported by journal bearings; that is, assessing the relative roles of the journal bearings and rotor system design in instability.

The rotor/bearing system has been studied using the impact test method [6]. The coefficients of the bearing forces were calculated from experimental data and used to obtain the stability region of the rotor system. An experimental technique has been proposed [7] and verified experimentally [8] for determining critical stability parameters. A simplified stability analysis for flexible rotors in tilting pad bearings [9, 10] provides a convenient and practical approach for considering nonsynchronous vibrations during the design of rotor/bearing systems. The relationship between the system damping factor and rotor stability is discussed.

It is known that self-excited vibration of compressors and turbines is due to a flow-induced force. This force can be represented in matrix form by a non-diagonal term. Stability of the rotor system is dependent on the coaction of the damping force of the bearing and the exciting force. This relationship has been studied [11] and the critical stability conditions

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for various bearing conditions obtained [12]. An approximate method has been developed [12] to calculate the optimum bearing or optimum support damping necessary to maximize stability in the vicinity of the first critical speed of multimass flexible rotors. An electromagnetic damper has been applied to a shaft to obtain satisfactory damping [14]. This external damper controls passage of the shaft through critical speeds and considerably delays the onset of any instability.

Analytical and experimental investigation with the squeeze-film damper [15, 16] showed the existence of an intershaft viscous damper instability. The squeeze-film damper was explored analytically and experimentally at an intershaft bearing location. It was shown that the rotating squeeze-film generates a synchronous driving force at low rotor speeds; the force drives the entire two-rotor system into a large uncontrollable whirl amplitude [15]. A spring attached in parallel with the squeeze-film damper was used to drive the instability onset speed out of the operating speed range of the rig [16]. This modification was designed into the rig and experimentally verified to be effective in controlling the instability onset speed.

Self-excited whirl at the threshold speed of instability has been investigated experimentally in rotors supported in fluid-film bearings [17]. A stability analysis of a multi-span rotor/journal bearing system has also been given [18].

Ball bearings. Ball bearings have nonlinear spring coefficients and sometimes induce instabilityin rotor systems. This problem has been analyzed [19].

FLUID FORCES

High-speed turbine generators and compressors experience nonsynchronous vibrations excited by a mechanism involving transformation of frictional or flow energy into vibrational energy. Such instability is classified as instability of pump and compressor, journal bearing instability, or labyrinth seal instability. Instability problems in rotors without journal bearing are reviewed in this section.

Pumps. In pumps the annular clearance spaces of the leakage path act as hydrostatic bearings. The hydrodynamic forces due to bearings acting on the rotor and synchronous forced whirling have been analyzed [20, 21]. Typical forced whirling response and stability results for a multistage rotor system have been published [22, 23]. Studies of the rotor dynamics of multistage turbine pumps have led Kikuchi [24] to conclude that both the seal clearance of the pump and the journal bearing have an effect on the stability of the rotor and unbalance response.

Severe vibration problems encountered during initial operation of large Deriaz pumps have been studied [25]; a procedure for satisfactory operation is described.

Compressors. The increasing use of flexible shaft centrifugal compressors has resulted in an increase in instability problems, particularly in high-pressure compressors, in which aerodynamic effects are important. Of course, nonsynchronous vibrations can occur in any machine unless careful consideration is given to all factors. Some current reports of field instability vibration data for minor design changes or major redesign contain discussions of fluid dynamic excitation [26-30].

Labyrinth seals. Aeroelastic instability in labyrinth seals is caused by shroud and shaft forces, but accurate test result and adequate theory are needed to calculate labyrinth seal whirl forces and to predict the stability of rotor systems. This problem has been reviewed [31], and a method for calculating labyrinth seal forces at threshold capacity has been published [32]. The effect of nonsynchronous precession on the seal force has been studied theoretically and analytically [33]. A non-rotating labyrinth seal has been considered [34]. A technique for calculating the seal force has been published [35]. The effect of shaft misalignment on seal force has been investigated [36]. It has been proposed that the seal force acts as a cross coupling term of the matrix in the rotor system [37-39]. An important example of steam whirl has been described [40]: if steam whirl occurs, the amplitude of the rotor increases suddenly. An experimental method has been reported in which the cross coupling term of the seal force can be obtained [41]; the results agree qualitatively with others [37, 38]. The effects of certain system parameters on the whirl excitation constant and radial stiffness of a model seal have been studied [42].

Despite the many investigations, however, the problem of the labyrinth seal has not yet been solved with sufficient accuracy for practical use. It thus remains an important problem.

PARAMETRIC EXCITATION

The angular velocity and torque change of a rotor driven through a universal joint depend on a rotor turn. This effect, which is nonlinear for the angle between input and output shaft, acts as a parametric excitation force to the rotor system. Instability due to the universal joint has been approached as a parametric excitation [43]. The dynamics of a gyroscope coupled to the universal joint and the effects of damping and mistuning on the performance of a dynamically-turned, multigimbal, universal joint gyroscope have been studied [44]. The dynamic stability of the gyro has been considered; rotor damping was shown to be a source of instability at rotor speeds in excess of the turning speed [45].

TORSIONAL VIBRATION

Torsional vibration of the crank shaft in a reciprocal engine can be reduced to a parametric excitation problem because the moment of inertia of each crank is a function of the rotating angle. This problem has been investigated [46, 47].

TORSIONAL-LATERAL VIBRATIONS

An important aspect of gear system dynamics is the resonant behavior of the gear train during steady-state operation. The variation of mesh stiffness during each tooth engagement is important even when the rotor is running at constant speed and load conditions. Torsional-lateral vibrations are coupled in a rotor system because of the resonant behavior of the gear train and the variation in mesh stiffness. When the rotor is supported in journal bearings, these factors can induce oil whip instability [48]. Steady-state response, resonances, and instabilities of pinion gear systems subjected to sinusoidal excitation have been studied using a computer simulation technique based on the phase plane method [49]. The same method has been used in many other cases [50].

Lund has proposed a method for calculating coupled torsional and lateral vibrations in a geared system of rotors [51]. The method considers both forced vibrations -- caused by mesh errors or mass unbalance -- and free, damped vibrations whose complex eigenfrequencies define the damped critical speeds and the stability of the rotor system. An analytical approach for studying the vibratory excitation of gear systems has been developed [52, 53]. The first part provides expressions for the Fourier-series coefficients of the vibratory excitation; in the second part the Fourier-series coefficients are expressed in terms of an easily interpreted gear tooth matrix.

ASYMMETRIC ELEMENTS

Instability of rotor systems with asymmetric elements was summarized in a 1979 review [54]. Since that review, a number of papers have been published. The relationships of stability region, eigenfrequency, and eigendamping have been shown for an asymmetric rotor with internal and external damping [55]. The position, width, and number of instability regions have been obtained, and dynamic behavior of a rotor for an asymmetric shaft supported by asymmetric flexible pedestals has been described [56]. Principal instability regions and sum-type combination resonance regions have been obtained for an asymmetric and mass distributed shaft supported by asymmetric bearings [57, 58].

The stability of a rotor with an asymmetric moment of inertia and stiffness and supported in an asymmetric bearing has been investigated [59]; the parameters and combination resonances for instability were obtained. Results for the same problem without the asymmetry of moments of inertia show that the number of possible resonances reduces to $f\ 2/4$ (f is the number of degrees of freedom); although parameter resonances arise only in the case of critical speeds of forward precession, combination resonances appear only as a sum of critical frequencies of a forward and backward precession [60]. The stability of a rotor supported by an asymmetric shaft in asymmetric bearings has been analyzed using Ljapnov's method and Fourier expansion [61]. The same problem has also been studied by another analytical method [62, 63]. In one case the character of subharmonic resonances was analyzed [63]. It has also been reported that gyroscopic action of the rotor tends to split the

unstable regions [64]. Stability of an asymmetric rotor supported in an electromagnetic journal bearing has been studied [65].

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LITERATURE REVIEW

survey and analysis of the Shock and Vibration literature

The monthly Literature Review, a subjective critique and summary of the literature, consists of two to four review articles each month, 3,000 to 4,000 words in length. The purpose of this section is to present a "digest" of literature over a period of three years. Planned by the Technical Editor, this section provides the DIGEST reader with up-to-date insights into current technology in more than 150 topic areas. Review articles include technical information from articles, reports, and unpublished proceedings. Each article also contains a minor tutorial of the technical area under discussion, a survey and evaluation of the new literature, and recommendations. Review articles are written by experts in the shock and vibration field.

This issue of the DIGEST contains an article about modeling of fluid transients in machines.

Dr. R. Singh of the Department of Mechanical Engineering, Ohio State University, has written Part II of a state-of-the-art literature review with emphasis on advanced mathematical modeling considerations.

MODELING OF FLUID TRANSIENTS IN MACHINES
Part II: Advanced Considerations

R. Singh[1]

Abstract - This paper is Part II of a state-of-the-art literature review; emphasis is on advanced mathematical modeling considerations. The following topics are discussed: modeling of turbomachinery and positive displacement machinery, dynamic coupling of machines, transient behavior of machinery systems and installations, multi-dimensional transients, two-phase flow, interaction between wave propagation and fluid flow modes, and experimental modeling methods.

Part I[2] of this paper dealt with basic equations, assumptions, and other factors involved in the mathematical modeling of fluid transients in machines [71]. Typical boundary conditions, source descriptions, and solution methods were given. Part II emphasizes advanced topics.

MODELING OF TURBOMACHINES

For the analysis of transient flows in turbomachines, it is assumed that the steady-state operational characteristic curves are also applicable to the perturbations. It is also assumed that the dimensionless-homologous characteristics are also valid for the pulsating or transient flows [11, 12, 65, 72-78].[3]

The relationship between pulsating variables[4] across a turbomachine running at a constant speed can be given as

$$\begin{Bmatrix} p_d - p_i \\ \rho_d Q_d - \rho_i Q_i \end{Bmatrix} = \begin{bmatrix} Z_{11} & Z_{12} \\ Z_{21} & Z_{22} \end{bmatrix} \begin{Bmatrix} p_i \\ \rho_i Q_i \end{Bmatrix}$$

Subscript i is for inlet quantities; d is for discharge quantities. The impedance matrix terms Z_{11} and Z_{12} can be obtained from the steady-state characteristics; Z_{11} is the pressure gain and Z_{12} is the slope of the head vs. flow rate curve [11, 12, 65, 72, 73]. For an incompressible fluid, in the absence of cavitation and any structural compliance, Z_{21} and Z_{22} are negligible. When the cavitation phenomenon is important, Z_{21} and Z_{21} must be incorporated [65, 74, 78].

Running speed variations can also be incorporated in the above matrix in order to study various dynamic problems dealing with load and speed changes. The impedance term relating flow variables to the speed change variable can be deduced in a quasi-steady state manner from the characteristic curves [65].

Impedance matrix terms can either be computed theoretically or determined experimentally. Analytical predictions are usually based on the two dimensional free stream-line cascade theory. The frequency response is calculated for the oscillating inlet conditions [73]. Experiments are designed to determine an individual impedance matrix term or its equivalent under controlled perturbations of the inlet flow [72]. However, much more work needs to be done before a complete understanding of the turbomachine transfer function is achieved. This is especially true for cavitation conditions at the inlet of a turbopump or at the discharge of a turbine.

Lumped parameter models have been used to describe the dynamic behavior of turbomachines [59, 65, 73]. Impedance matrix terms can be modeled as discrete dynamic elements; e.g., Z_{11} as a gain amplifier, Z_{12} as a resistance, Z_{21} as a compliance element, Z_{22} as a gain amplifier. Discharge and inlet lines can also be modeled as discrete elements.

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[3] *References 1-70 are given in Part I*

[4] *For definition of variables, see Part I*

MODELING OF POSITIVE DISPLACEMENT MACHINES

Periodic flow variations are inherent in a positive displacement machine because of its kinematics. Consider a single cylinder machine with suction and discharge pipes. Unsteady flows in suction and discharge pipes, generated by the reciprocating action of the piston, are aided and modulated by the rapid opening and closing of valves. Pulsating flows are excited at the fundamental running speed and its higher harmonics [6-9, 23, 56-64, 79-91].

The basic processes of a positive displacement machine are interactive; for example, the fluid pulsations affect cylinder pressure, instantaneous mass flow rates, and valve displacements. Because of these dynamic interactions a simultaneous solution of mathematical models describing all basic processes has gained acceptance as a recommended procedure [60-64, 81-91]. For example, the following models are required to describe the source and fluid transient system for a compressor: cylinder thermodynamics, fluid flow through valves, valve structural dynamics, kinematics, suction and discharge manifolds, mufflers, and piping boundary conditions [61, 63, 82, 85, 87-89, 91].

Fluid oscillations are further complicated in a multi-cylinder machine because of the dynamic interactions between cylinders; such interactions can be identified and modeled as kinematic and geometric types of coupling [61, 63, 88-91]. The kinematic coupling effect is usually incorporated in the mass flow rate variables; the geometric coupling terms are included in an impedance matrix [61]. An alternate method of modeling multi-cylinder machinery manifolds involves a lumped parameter Helmholtz resonator approach [23, 60, 69, 91].

It is important to be able to calculate the effect of fluid transients on the thermodynamic efficiency and mass flow rate capacity. Various investigators have shown that adverse pulsations can drastically reduce thermodynamic efficiencies [6, 82, 92-94]. On the other hand, favorable pulsations, usually achieved through tuning, can improve mass flow rates and thus dramatically influence energy consumption or production efficiency [62, 82, 92-94]. Much work remains to be done in this area, especially for multi-cylinder machines [61]. Such similar studies as the analysis of a variable displacement pump are underway [30].

MODELING OF MACHINERY SYSTEMS

Machines are often an integral part of systems and installations; their fluid transient behavior is therefore strongly dependent on dynamic interrelationships with other components. An installation generally consists of several machines and such components as associated piping, valves, speed control mechanisms, and safety devices. Fluid transients are often caused by the following situations: sudden power failure, sudden start-up and stoppage of machines, abrupt changes in valve adjustment, load variations, and unstable operation [95-105]. Depending upon the situation and the installation network, the problem can either be truly transient or of the steady-state oscillation type. Both the method of characteristics approach and the linear impedance/transfer matrix approach have been successfully used to model and diagnose these problems [8-12, 95-105].

An additional complication can arise due to the cascading of machines -- that is, combining machines in series or in parallel. Such combinations form a dynamically coupled system; consequently, fluid pulsations are complicated [6, 12]. Pressure oscillations in a pipe between the interstaged machines are often pronounced [6].

MULTIDIMENSIONAL FLUID TRANSIENTS

Because the transverse dimensions of fluid-containing devices are generally smaller than the wavelength of interest -- which is dictated by the highest analysis frequency -- a one-dimensional model is sufficient. However, a two- or three-dimensional model may be required if the tranverse dimensions are large or a higher frequency range of analysis is desired [106-111].

Multidimensional models are complicated and costly. Unlike the one-dimensional model, the characteristics of multidimensional models can no longer be described by lines on a t-x plane; rather, a spatial description is required [107, 108]. An alternate simple approach is to represent flow by a lattice vork of one-

dimensional flow elements, provided an account for the element overlapping is made [109]. This method is applicable only at low Mach numbers. As with some one-dimensional models, the finite-difference technique is used with multidimensional models [107, 109].

The finite element modeling technique has also been used in some cases [110, 111]. The NASTRAN program has only an axisymmetric finite element model; this model not suitable for some multidimensional problems [110]. Work in this area is currently in progress.

TWO-PHASE FLOW TRANSIENTS

Two-phase flow transients occur in the following cases: gas trapped in liquid systems, formation of gas or vapor bubbles by lowering pressures or increasing temperatures, and mixing of liquid and gas stream [112-128]. For modeling purposes, the dynamics of gas or vapor bubbles -- which depend on the amount, distribution, and size of the bubbles -- should be accounted for. These characteristics vary with time and thus are very difficult to assess. One technique relies on correlating the concentration of bubbles with the speed of wave propagation -- but the speed of propagation is no longer a constant [123-125]. Because of the complexity of the situation, therefore, very few modeling efforts have been successful [126-128].

The separated-flow model assumes that gas and liquid flow in separate regions [126]. A two-phase interface node description has been used to predict transients and steady state behavior of an engine carburetor reasonably well [128]. An implicit finite-difference technique was used for computations.

There is a strong need for basic mathematical and experimental models in the general area of two-phase flow. In particular, prediction and avoidance of cavitation phenomenon is important for the design and operation of machines and power-generating units [74-78, 111-113, 119-121]. Research in this area is currently in progress.

WAVE PROPAGATION AND FLUID FLOW INTERACTION

The development of wave propagation equations generally assumes that fluid flow and wave propagation modes are not coupled. However, many interesting physical phenomena exist due to the higher order coupling of these two modes; these phenomena are generally nonlinear [129-133].

Fluid-wave interaction effects can be categorized as a connective effect due to fluid flow, fluid-induced damping of the wave propagation, and fluid-induced oscillation and wave amplification. Some of these effects have already been covered in Part I of this review. Interactions between fluid and wave modes are more pronounced when the flow velocities (u_o) are higher and/or wave perturbation velocity (u) is finite [129-132].

Self-sustaining oscillations of flow cavities can be attributed to the instability of cavity shear layer and a feedback mechanism or to the excitation of fluid resonances by fluid flow or a solid boundary [133-136]. Wave propagation pressure amplitudes can also be amplified if a mechanism exists for continuous feed of energy from the fluid mode [131, 132]. Such effects have not yet been incorporated in mathematical models.

EXPERIMENTAL MODELING

Experimental methods are used to study physical phenomena and to verify results predicted by mathematical models. For complicated fluid transient systems and phenomena, it is not always possible to develop a model from theory. Consequently, experimental modeling methods are used [137-139].

A need for efficient and reliable experimental methods exists so that the inherent characteristics of fluid elements can be determined effectively without any influence from the machinery sources and terminations. The model experimentally obtained should possess both magnitude and phase information in order to describe fluid elements completely. This makes the concept of a building-block approach feasible when experimentally and analytically obtained transfer functions can be combined to build an overall mathematical model [139-140].

CONCLUDING REMARKS

This paper has been a state-of-the-art literature review of mathematical models applied to the study of transient and steady state flows in machinery. Because space limitations prevent lengthy discussions of many pertinent topics, the interested reader is referred to the references.

One question that has not been adequately explored is whether these mathematical models are only research tools or can be applied to conventional machine design and development. The answer lies somewhere in between. The state of the art is such that a designer can effectively incorporate some basic models into his analysis and obtain his decisions accordingly. However, sophisticated models are such that additional fundamental work must be done before technology transfer can take place. In this context, the use of finite-element programs for fluid transient problems should bring designers and non-experts closer to mathematical models. General purpose computer programs are not presently available; therefore, the fluid transients research should be concentrated in this area.

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BOOK REVIEWS

WIND FORCES IN ENGINEERING

Peter Sachs
2nd Edition, Pergamon Press
Elmsford, New York, 1978

Wind forces acting on structures have become more significant as structures have become larger, lighter, and more slender due to the use of high-strength materials. The original goal of the author was to present engineers with simple methods for predicting structural responses to wind forces. The second edition of the book includes information published since 1971.

The book covers the following major subject areas:

(1) Introduction - Chapter 1 presents an overview of the book.

(2) Wind Forces - General data on wind forces are given in Chapters 2 and 3. General worldwide air movements, wind measurement techniques, and analysis of wind data are discussed in Chapter 2; tropical storms and tornados, effect of climatological and topographical variations, and design requirements for wind data are also considered. After wind speed is known, the wind force acting on a structure can be determined by multiplying the dynamic head of wind by the area of the structure and a dimensionless shape factor. The shape factor for basic shapes and structural sections as well as pressure coefficients are given in Chapter 3.

(3) Wind-Tunnel Techniques - When the full-scale structure cannot be tested or analyzed, wind-tunnel tests on a structural model are needed. Chapter 4 is devoted to measurements of structural models in wind tunnels; included are flow characterization in wind tunnels, model similarity laws, measurements of pressure and various excitation forces, blockage and corrections, and comparison of natural wind and tunnel turbulence.

(4) Wind-Induced Oscillations - Dynamic responses of discrete and continuous structures subjected to wind forces are presented in Chapter 5. The excitation mechanisms include vortex shedding, turbulence, and fluid-elastic instability. Structural responses are discussed in terms of structural deflection, stress, and fatigue criteria.

(5) Applications - Chapters 6 to 9 consider wind forces on structures: bridges (Chapter 6), buildings (Chapter 7), masts and towers (Chapter 8), and special structures such as cables, cooling towers, and communication antennae (Chapter 9). In each chapter general parameters of wind flow and structural response, static wind forces, and dynamic wind effects are emphasized. Wind forces vary, depending on the structure. Wind effects, characteristics, and model tests of bridges are discussed; aerodynamic instabilities associated with partially completed bridges and wake-induced instability are also considered.

General factors associated with buildings include main flow, secondary flow, surface wind pressure, and the effect of neighboring buildings for tall, long low, and equal-sided buildings and for roofs.

The dynamic characteristics of masts and towers, including mode shapes, natural frequencies, and damping of different types of construction, are discussed. The responses to static and dynamic forces are presented. Such structures as antennae with special shapes generally require attention because of their functions. Static and dynamic responses are considered, including analysis and model tests.

Chapter 10 contains a comparison of four Codes of Practice: British Standard Institution, National Building Code of Canada, American National Standard, and Australian Standard. Four appendices present notation used in Chapters 1 to 9, standard aerodynamic and conversion data, characteristics of wind-measuring instruments, and shelter effects. A list of 183 references is also given.

In summary, this book presents basic design information and simple analytical techniques. It will be useful to design engineers as well as researchers in wind engineering. The author has successfully achieved his goal of presenting a coherent view of the major fields in wind engineering.

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LINEAR DYNAMIC SYSTEMS

John B. Lewis
Matrix Publishers, Inc., Champaign, IL, 1977

This book by John B. Lewis, a professor of electrical engineering at Pennsylvania State University, treats general dynamic systems and is not restricted to any single discipline. It is long (862 pages); the treatment is at an advanced level, and the scope and breadth are ambitious. This reviewer would have reservations about assigning it as a text, because the reader should be comfortable with advanced matrix theory, integral transforms, complex variables, and stochastic processes. Although some of this material is reviewed in appendices and all mathematical theorems are presented without proof, such requirements would be a challenge for the typical engineering student.

The book is organized into six chapters and four appendices. Chapter 1 gives an overview of physical modelling, identification of systems, signal processing, frequency, and time domain analyses. Chapter 2 opens with a discussion of continuous and discrete time signal models, both deterministic and random, and their representation in terms of elementary functions (sinusoidal, exponential, singularity). Complete orthogonal sets of functions such as Legendre, Laguerre, and Walsh are also treated. Frequency domain concepts are introduced through Laplace, Fourier, and z-transforms. A thorough treatment of various spectra and auxiliary functions such as cross-correlations is then presented. The chapter closes with extensive coverage of signal conversions — sampling, quantization, reconstruction, and dequantization.

Chapter 3 is concerned with the mathematical modelling of systems, the emphasis being on differential and difference equations. In addition to traditional material, the state equation approach is covered. The reader is required to be familiar with the Sylvester and Cayley-Hamilton theorems, the resolvent matrix, and the Jordan canonical form in order to understand the discussion on numerical approaches to the state transition matrix. Such standard forms of the matrices as primal, Jordan, and cascade are treated, as well as the concepts of controllability and observability of systems.

Chapter 4 has to do with the deterministic and random responses of linear systems. Classical methods for obtaining responses are reviewed, and the state variable approach is introduced. Methods for calculating the numerical values of system parameters are presented; two basic approaches are the use of test inputs and input-output analyses.

Chapter 5 is concerned with system performance. Numerous theorems on Liapunov, asymptotic, exponential, and total stability are cited. Stability tests such as that of Hurwitz are given, as is a treatment of Liapunov theorems. The concept of response fidelity -- that is, the difference between a desired and actual response -- is reviewed, various point and functional measures are explored. Such sensitivity measures as performance, trajectory, and eigenvalue sensitivities are introduced and discussed. The section closes with a treatment of reliability for both individual components and the system as a whole.

Chapter 6 presents four major applications of the concepts and methodologies developed, with the relevant modelling equations being derived as needed. The first application is signal processing, discrete Fourier transforms are introduced. The second application involves a network in which constant inductors, resistors, and capacitors, as well as ideal current and voltage sources are treated. A problem involving the design of an automatic aircraft controller for the final phase of landing is given. A state variable model of a synchronous motor is analyzed.

Among the four appendices, A, B, and C present Fourier, Laplace, and z transforms, matrices and vector spaces, and probability and random processes respectively. A digital program is given in D for use with state variable models.

Though I would be hesitant to assign the book as a text to any but the best engineering class, I find that the copious references and the broad, deep coverage make it a valuable addition to my reference library, and I highly recommend it as such.

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PROCEEDINGS OF NOISE-CON 79: MACHINERY NOISE CONTROL

Institute of Noise Control Engineering
and the Noise Control Foundation
Poughkeepsie, New York, 1979

These are the Proceedings of the Third National Meeting on specialized noise topics. The conference was divided into ten parts, as is the book. Two introductory articles on Environmental Protection Agency activities and regulations are followed by a section on Agricultural and Construction Equipment Noise. The four papers in this section complement each other. Two provide summaries of practical structural modifications for tractors and bulldozers, the other two give details of specific engine-related modifications. Noise is reduced considerably when mufflers and fan drives are modified.

A section on noise of machine elements includes a rigorous analysis of circular saw blade noise, axial flow fan noise, and a general introduction to finite element modeling of impact loadings. Circular saw noise is the topic of two additional papers. Of immediate use in plants is the paper on vibratory equipment noise abatement, an evaluation of elastomers on rolling contract surfaces is given for present and future machinery modifications.

"Forging and Impact Noise" begins with overviews of cold heading noise and control, noise reduction, and increased productivity in forging, research objectives and advice are given, as are specific discussions of shock absorbers utilized to reduce punch press noise and the use of noise analysis procedures on a large dieing machine.

"Diagnostic Noise Measurements" contains a description of the program of computerized noise modeling at General Motors; results of specific studies are presented. Two theoretical analyses using surface intensity measurements are included. A general test description is followed by a report of a specific investigation of a vibrating cylinder. The possibilities of viscoelastic damping of structures are noted, and a simple, practical microphone coupler for field noise work is introduced. Additional information on saw and scrap chopper noise is given in "Metal Cutting Noise." Potential solutions are presented.

All of the sections in this book could be read and possibly adapted to other noise problems and industries; this is particularly true for the papers in the section on compliance noise measurements. A discussion of EPA enforcement of truck and compressor noise regulations is followed by data on an indoor simulation of an SAE truck noise testing procedure. "Survey Procedures for the Dairy Packaging Industry" and "Noise Emissions Measurements for Computer and Business Equipment" also are potentially useful in other fields. The paper "Noisiness of Impulsive versus Steady Noise" is especially noteworthy.

"Noise of Engines and Components" deals with the isolation of engine components; specific theoretical information on piston impact noise, crankshaft torsional vibration, and muffler and exhaust system acoustic parameters is given.

"An Overview of Mining Industry Noise" begins the section on mining equipment noise. Specific aspects covered include diesel powered underground and surface mining equipment, long-hole drilling machines, and pneumatic mine roof drills.

"Hydraulic and Pneumatic System Noise" should be useful to many industries. A general information section and detailed discussions of flow noise at acoustic pipe coincidence and the noise characteristics of control valves are included, as is information on the noise reduction of a small portable air compressor.

The last collection of papers is on "Machinery Noise in Factory Spaces." A description of the performance of absorptive treatments includes analysis and experi

ment. Foundry acoustical barriers are investigated. A paper on "Free Field Rooms for Industrial Applications" could be considered part of this section but also has general applications in industry and research.

The organizers of the conference are to be commended for including a variety of topics, authors, and viewpoints. Anyone involved with machinery noise and vibration will find helpful ideas, both for specific jobs and for comprehensive coverage of related fields.

S.P. Engstrom
Systems Proposals
McDowell-Wellman Company
Cleveland, OH 44114

SHORT COURSES

JULY

INDUSTRIAL PRODUCT NOISE CONTROL

Dates: July 7-11, 1980
Place: Schenectady, New York
Objective: Designed for engineers, designers, environmental health specialists, and managers concerned with noise and vibration control. The course will provide information on the theory, measurement, and economics of noise reduction. It will cover the latest information on the nature of sound and noise control, including noise criteria, airborne sound distribution, vibration control, and noise signature analysis. Other topics include how noise is produced by different types of engineering equipment such as compressors, electric motors, fans, valves, and transformers.

Contact: Graduate Studies and Continuing Education office, Wells House, 1 Union Ave., Union College, Schenectady, NY 12308 - (518) 370-6288.

MACHINERY VIBRATION ANALYSIS SEMINARS

Dates: July 9-10, 1980
Place: New Orleans, Louisiana
Dates: August 12-13, 1980
Place: Sheraton Inn-Newark Airport, NJ
Dates: October 1-2, 1980
Place: Houston, Texas
Objective: These two day seminars on machinery vibration analysis will be devoted to the diagnosis and correction of field vibration problems. The material is aimed at field engineers. The sessions will include lectures on the following topics: basic vibrations; critical speeds; resonance; torsional vibrations; instrumentation, including transducers, recorders, analyzers, and plotters; calibration; balancing and vibration control; identification of unbalance, misalignment, bent shafts, looseness, cavitation, and rubs; advanced diagnostic techniques; identification of defects in gears and antifriction bearings by spectrum analysis; and correction of structural foundation problems.

Contact: Dr. Ronald L. Eshleman, Vibration Institute, 101 W. 55th St., Suite 206, Clarendon Hills, IL 60514 - (312) 654-2254/654-2053.

ADVANCED DYNAMIC ANALYSIS FOR MODAL TESTING USERS

Dates: July 9-10, 1980
Place: Cincinnati, Ohio
Objective: This seminar has been organized to provide the serious user (advanced and beginner alike) with a complete knowledge of the capabilities and applications of the SDRC Testing Software Package (MODAL, MODAL-PLUS, SABBA and FATIGUE). The emphasis will, therefore, be on advanced software capabilities and their use to solve dynamics problems. Applications will come from the vehicle, construction and mining equipment, and rotating equipment areas; but, will be of general interest to any engineer working in the area of experimental dynamics.

Contact: Mrs. Gayle Lyons, SDRC Seminar Coordinator, Structural Dynamics Research Corp., 2000 Eastman Drive, Milford, OH 45150 - (513) 576-2594.

PLANNING A DIGITAL DATA ACQUISITION AND CONTROL COMPUTER SYSTEM

Dates: July 9-11, 1980
Place: Schenectady, New York
Objective: Will deal with the interconnection of a multitude of devices from sensors to final control elements with ultimate output of system conditions on the man-machine interface devices; the sensing of temperature, pressure, level, flow, speed, weight, torque, vibration and electrical parameters such as volts, amps, watts, vars, power factor, frequency, and motor load. The flexibility and utilization of data presentation via dynamic, colored graphic and tabular CRT displays will be presented as an optimum man-

machine interface. System components/hardware and their interconnection will be discussed in depth. Staging, on-site testing, and as-built documentation will be the final steps in planning a digital acquisition and control computer system.

Contact: Graduate Studies and Continuing Education office, Wells House, 1 Union Ave., Union College, Schenectady, NY 12308 - (518) 370-6288.

FRACTURE MECHANICS I AND ITS APPLICATION TO ENGINEERING DESIGN

Dates: July 14-18, 1980

Place: Schenectady, New York

Objective: Material covered in "Fracture Mechanics I" will benefit anyone in an engineering related position who is concerned with the application of fracture mechanics to the prevention of brittle fracture such as pressure vessels for power generation, malleable iron castings, structural steel fabricated frameworks, and ASME Pressure Vessel code applications. Included are the engineering approach to component failure; failure analysis of pressure vessels; fracture mechanics based toughness criteria in ASME Pressure Vessel code; examples and case histories of code fracture mechanics applications; elastoplastic analysis; computer aids for calculating remaining cyclical life; crack initiation and propagation; life prediction; and non-destructive testing methods and capabilities.

Contact: Graduate Studies and Continuing Education office, Wells House, 1 Union Ave., Union College, Schenectady, NY 12308 - (518) 370-6288.

APPLIED INSTRUMENTATION AND MEASUREMENTS ENGINEERING

Dates: July 14-18, 1980

Place: Schenectady, New York

Objective: Designed for technicians, engineers, and managers involved in the field of instrumentation and measurements. It will present a comprehensive view of the instrumentation system from transducer to readout, including a major emphasis on computer interfacing techniques. Principal topics will include philosophy of measurements, transducer operating principles and selection criteria, static and dynamic data acquisition systems, occurrence and prevention of noise in measurement systems, data reduction methods, digital techniques, and statistical treatment of data. "Hands-on" lab experience will be offered.

Contact: Graduate Studies and Continuing Education office, Wells House, 1 Union Ave., Union College, Schenectady, NY 12308 - (518) 370-6288.

INTRODUCTION TO THE VIBRATION AND STRESS ANALYSIS OF PRESSURE ACTUATED VALVES FOR GAS COMPRESSORS USING FINITE ELEMENT METHODS

Dates: July 21-22, 1980

Place: Purdue University

Objective: The course content is general to many fluid machinery systems utilizing pressure actuated flexible valves, however, class examples will emphasize small, high-speed, refrigerant compressors. Interest is directed to the development of suitable mathematical models for the prediction of the dynamic motion of the flexible valve during the compressor cycle and the resultant stress field in the valve. Participants should be familiar with the mathematical simulation philosophy for compressors. Extension of the valve modeling to more detailed descriptions compatible with the general compressor simulation will be presented.

Contact: James F. Hamilton, Ray W. Herrick Laboratories, School of Mech. Engrg., Purdue University, West Lafayette, IN 47907.

PROBABILISTIC ANALYSIS OF VIBRATIONS

Dates: July 21-23, 1980

Place: Irvine, California

Objective: Topics include: fundamentals of probability theory; response of one degree of freedom systems; cross correlation and cross spectral density of force and response; several random point forces, random distributed forces; joint acceptance functions, coherence functions and their application; probability distribution of stress, fatigue; statistical energy analysis; applications in aeronautical engineering; applications in mechanical engineering, applications in civil engineering.

Contact: Computation Mechanics, P.O. Box 4174, Irvine, CA 92716

FRACTURE MECHANICS II WITH INDUSTRIAL APPLICATIONS

Dates: July 21-24, 1980
Place: Schenectady, New York
Objective: Designed for engineers with responsibility and management of fracture analysis and prevention. Some knowledge of fracture mechanics is assumed, since this course represents advanced, "state-of-the-art" fracture mechanics as applied in the pressure vessel and piping fields. Major topics are: fundamental concepts; estimation of plastic zone size; "J" integral and methods for estimation; fundamentals and computer applications of finite element methods to notches and cracks; special topics in advanced analytical methods; selected applied industrial problems; metallurgical aspects of high toughness materials; residual stresses; service environment; "state-of-the-art" in testing for use of small speciments; finite element applications; and elasto-plastic fracture toughness - "R" curves.

Contact: Graduate Studies and Continuing Education office, Wells House, 1 Union Ave., Union College, Schenectady, NY 12308 - (518) 370-6288.

FINITE ELEMENT METHOD IN MECHANICAL DESIGN

Dates: July 21-25, 1980
Place: University of Michigan
Objective: The course is intended for engineers working in mechanical design or analysis where knowledge of stresses, displacements or vibration is required. No previous experience with finite elements is assumed. The course will reveal the fundamentals on which the method is based and will familiarize the attendee with modeling concepts. A number of practical examples will be presented. Laboratory work will be emphasized and each attendee will be encouraged to create his own finite element models of simple mechanical systems. Topics include: historical review, technical review, line element, assembly of elements, constant strain triangle, virtual work derivation of general equations, equation solvers, natural coordinates and isoparametric elements, heat conduction element, plate and shell element, and general purpose computer programs.

Contact: Engineering Summer Conferences, 400 Chrysler Center, North Campus, The University of Michigan, Ann Arbor, MI 48109 - (313) 764-8490.

COMPUTER WORKSHOP IN EARTHQUAKE AND STRUCTURAL DYNAMICS

Dates: July 28 - August 1, 1980
Place: Schenectady, New York
Objective: This course will cover structural dynamics techniques for both linear and nonlinear many-degree-of-freedom systems. Special emphasis will be given to seismic applications such as NRC requirements. Random vibration methods will be presented, and response spectrum methods for many-degree-of-freedom systems will be given. In addition, a nonlinear dynamics computer program, as well as eigenvalue and sinusoidal analysis programs, will be available for workshop use. Listings of these programs and relative merits of ANSYS, SAP, and ADINA programs will be discussed. Computer graphics for input generation and output presentation, as well as applications to current technological problems will be given, including earthquake analysis, pipe whip dynamics, shock response of electronic cabinets, fluid-solid interaction, and self-excited vibrations of a multimodal structure. FORTRAN computer programs will be presented for multi-degree-of-freedom systems, and will be applied to tutorial and student generated problems.

Contact: Graduate Studies and Continuing Education office, Wells House, 1 Union Ave., Union College, Schenectady, NY 12308 - (518) 370-6288.

COMPUTER WORKSHOP IN FINITE ELEMENT METHODS OF ANALYSIS FOR STRESS AND OTHER FIELD PROBLEMS

Dates: July 28 - August 1, 1980
Place: Schenectady, New York
Objective: This course will cover finite element techniques for 2D and 3D structural analysis and dynamics. Both 2D and 3D programs, including listings, will be available for student use. Generalization of finite element methods to heat transfer and fluid flow will be given with programs in each discipline. In addition, incremental loading into the plastic range and finite element methods in fracture mechanics will be presented. Relative merits of ANSYS, SAP, ADINA, and other programs will be discussed, and computer graphics for input generation and output presentation will be given. Applications to current technological problems will include thermal and stress analysis of nuclear vessel nozzle, 3D pipe intersection, turbine blade application, and water mass of

nuclear fuel channels. FORTRAN IV computer programs for both 2D and 3D problems will be presented and applied to tutorial and student generated problems.

Contact: Graduate Studies and Continuing Education office, Wells House, 1 Union Ave., Union College, Schenectady, NY 12308 - (518) 370-6288.

DYNAMICS AND CONTROL OF LARGE FLEXIBLE SPACE STRUCTURES

Dates: July 28 - August 1, 1980
Place: UCLA
Objective: The theme of the course is the need to integrate the understanding of physical system dynamics with the methods of modern control theory to accomplish the practical control of the class of large, flexible spacecraft of current interest. Attention focuses initially on the idealization of spacecraft structures and the formulation of their equations of motion. Dynamics and control theory are then developed in integrated terms, with emphasis gradually shifting to the applications of modern control theory. The limitations of conventional optimal estimation and control theory for such applications are illustrated, and various techniques for reducing the sensitivity of conventional methods to modeling errors are presented.

Contact: Continuing Education in Engineering and Mathematics, P.O. Box 24901, UCLA Extension, Los Angeles, CA 90024 - (213) 825-1295 or 825-3344. Western Union: KDU

AUGUST

FINITE ELEMENT ANALYSIS IN FLUID DYNAMICS

Dates: August 4-8, 1980
Place: Knoxville, Tennessee
Objective: This course is designed to familiarize the engineer/scientist with the basic concepts and practice of finite element methodology; to detail step-by-step numerical solutions for elementary but highly informative ideal flows; to extend these developments to nonlinear problems, building directly upon introductory concepts, to expose the important aspects of the mathematical theory and make detailed comparison to conventional procedures; to expand applications to turbulent and compressible flows over a range of Mach and Reynolds numbers; and to introduce and correlate the newest developments including tensor products, optimal control, constrained optimization.

Contact: Eunice Hinkle, Department of Engineering Science and Mechanics, University of Tennessee, 317 Perkins Hall, Knoxville, TN 37916 - (615) 974-2171.

NOISE ANALYSIS

Dates: August 6-7, 1980
Place: Cincinnati, Ohio
Objective: This seminar will provide engineers concerned with noise analysis and control an introduction to the most current technology in this area. The session will be dedicated to presenting the latest noise analysis procedures, and the various noise control measures which can be employed, primarily related to product noise. Topics discussed will include: physical acoustics, psycho-acoustics, time series analysis, source identification, structural frequency response, noise control, absorption, barriers, isolation, stiffening, and damping.

Contact: Mrs. Gayle Lyons, SDRC Seminar Coordinator, Structural Dynamics Research Corp., 2000 Eastman Drive, Milford, OH 45150 - (513) 576-2594.

FATIGUE ANALYSIS

Dates: August 13-14, 1980
Place: San Diego, California
Dates: September 10-11, 1980
Place: Cincinnati, Ohio
Objective: The growing understanding of the important factors in the fatigue failure process coupled with the accumulation of new, correctly obtained, fatigue test data and material property and behavior data, has led to the practical application of fatigue analysis methods. The vast improvements in stress analysis, both computerized design analysis (finite element methods, etc.) and experimental testing techniques (digital Fourier analysis, cycle counting methods, etc.) have enabled engineers and designers to get a more fundamental understanding of fatigue. The seminar will address the topics of cyclic stress-

strain behavior of metals, fatigue properties of metals and cumulative damage procedures.

Contact: Mrs. Gayle Lyons, SDRC Seminar Coordinator, Structural Dynamics Research Corp., 2000 Eastman Drive, Milford, OH 45150 - (513) 576-2594.

PYROTECHNICS AND EXPLOSIVES

Dates: August 18-22, 1980

Place: Philadelphia, Pennsylvania

Objective: The seminar combines the highlights of "Pyrotechnics and Solid State Chemistry," given the last eleven summers, and "Explosives and Explosive Devices" that made its successful appearance nine years ago. Similar to previous courses, the seminar will be practical so as to serve those working in the field. Presentation of theory is restricted to that necessary for an understanding of basic principles and successful application to the field. The seminar will be welcomed both by newcomers to the field as well as by experienced men who wish to brush up on latest developments. Coverage emphasizes recent effort, student problems, new techniques, and applications. The prerequisite for this seminar is a bachelor of science degree in engineering or equivalent.

Contact: Mr. E.E. Hannum, Registrar, The Franklin Research Center, Philadelphia, PA 19103 - (215) 448-1236/1395.

HIGH-SPEED COMPUTATION: VECTOR PROCESSING

Dates: August 18-22, 1980

Place: University of Michigan

Objective: In this course, the architectural, software, and algorithmic issues are covered by (a) background discussions of formal theory of parallel and vector algorithms with applications, and (b) presentations on four current vector processors and their application to large scientific and engineering problems. The course will consist of lectures and informal laboratory sessions with counseling. Three major vector processors - the Burroughs BSP, the Control Data CYBER 203, and the Cray Research CRAY-1 - are all available for benchmarking for the first time. Arrangements have been made to have both remote, high-speed access and site counselors from the processor manufacturers. The serious student should have adequate access to all of the processors to achieve at least local vectorization of small FORTRAN programs and to invoke special vector constructs and available mathematical software (equation and recurrence solvers, FFT's, etc.).

Contact: Engineering Summer Conferences, 400 Chrysler Center, North Campus, The University of Michigan, Ann Arbor, MI 48109 - (313) 764-8490.

MACHINERY VIBRATION ANALYSIS

Dates: August 26-28, 1980

Place: Las Vegas, Nevada

Dates: December 10-12, 1980

Place: New Orleans, Louisiana

Objective: The course covers causes, effects, detection, and solutions of problems relating to rotating machines. Vibration sources, such as oil and resonant whirl, beats, assembly errors, rotor flexibility, whip, damping, eccentricity, etc. will be discussed. The effect on the overall vibration level due to the interaction of a machine's structure, foundation, and components will be illustrated.

Contact: Bob Kiefer, Spectral Dynamics, P.O. Box 671, San Diego, CA 92112 - (714) 268-7100.

SEPTEMBER

UNDERWATER ACOUSTICS

Dates: September 8-12, 1980

Place: University Park, Pennsylvania

Objective: This is a concentrated course designed to cover the basic principles of underwater acoustics as well as current research and recent developments in the field. The course is intended to serve as an introductory course for those who are new to the field but have the appropriate educational background; and as a refresher course for scientists, engineers, program managers, and administrators engaged in underwater acoustics. Topics will include: basic acoustics; sonar concepts; ambient noise; reverberation; underwater acoustics transmission; transducer concepts; nonlinear acoustics/parametric arrays; target physics; and flow noise.

Contact: Robert E. Beam, Conference Coordinator, Pennsylvania State University, Faculty Building, University Park, PA 16802 - (814) 865-5141.

9TH ANNUAL INSTITUTE ON THE MODERN VIEW OF FATIGUE AND ITS RELATION TO ENGINEERING PROBLEMS

Dates: September 8-12, 1980

Place: Schenectady, New York

Objective: This course will emphasize the relationships of our current physical and phenomenological understanding of fatigue to the engineering treatment of the problem. The curriculum will be built around the several stages of the fatigue process including consideration of the plastic zone, crack nucleation and early growth, crack propagation in the plastic regime, crack propagation in the elastic regime, and failure. Examples from service failures will be introduced when appropriate.

Contact: Graduate Studies and Continuing Education, Union College, Wells House, 1 Union Ave., Schenectady, New York 12308 - (518) 370-6288.

BLASTING AND EXPLOSIVES SAFETY TRAINING

Dates: September 10-12, 1980

Place: Atlantic City, New Jersey

Dates: September 24-26, 1980

Place: Des Moines, Iowa

Dates: October 8-10, 1980

Place: Nashville, Tennessee

Dates: October 22-24, 1980

Place: Casper, Wyoming

Dates: November 5-7, 1980

Place: Hershey, Pennsylvania

Dates: November 19-21, 1980

Place: Lexington, Kentucky

Objective: This course is a basic course that teaches safe methods for handling and using commercial explosives. We approach the problems by getting at the reasons for safety rules and regulations. Helps provide blasters and supervisors with a practical understanding of explosives and their use - stressing importance of safety leadership. Familiarizes risk management and safety personnel with safety considerations of explosives products and blasting methods.

Contact: E.I. du Pont de Nemours & Co. (Inc.), Applied Technology Division, Wilmington, DE 19898 - (302) 772-5982/774-6406.

VIBRATION AND SHOCK SURVIVABILITY, TESTING, MEASUREMENT, ANALYSIS, AND CALIBRATION

Dates: September 15-19, 1980

Place: Ottawa, Canada

Objective: Topics to be covered are resonance and fragility phenomena, and environmental vibration and shock measurement and analysis; also vibration and shock environmental testing to prove survivability. This course will concentrate upon equipments and techniques, rather than upon mathematics and theory.

Contact: Wayne Tustin, 22 East Los Olivos St., Santa Barbara, CA 93105 - (815) 682-7171.

9TH ADVANCED NOISE AND VIBRATION COURSE

Dates: September 15-19, 1980

Place: Institute of Sound and Vibration Research, University of Southampton, UK

Objective: The course is aimed at researchers and development engineers in industry and research establishments, and people in other spheres who are associated with noise and vibration problems. The course, which is designed to refresh and cover the latest theories and techniques, initially deals with fundamentals and common ground and then offers a choice of specialist topics. The course comprises over thirty lectures, including the basic subjects of acoustics, random processes, vibration theory, subjective response and aerodynamic noise, which form the central core of the course. In addition, several specialist applied topics are offered, including aircraft noise, road traffic noise, industrial machinery noise, diesel engine noise, process plant noise, and environmental noise and planning.

Contact: Mrs. O.G. Hyde, ISVR Conference Secretary, The University of Southampton, S09 5NH UK-Southampton (0703) 559122, Ext. 2310 or 752, Telex: 47661.

MODAL ANALYSIS

Dates: September 17-19, 1980

Place: Cleveland, Ohio

Objective: This seminar will provide information on new techniques for identifying dynamic structural weaknesses. The sessions include the use of

state-of-the-art instrumentation and software for creating a dynamic structural model in the computer. Techniques will be demonstrated for mode shape calculation and animated displays, computation of mass, stiffness and damping values and modal manipulation methods.

Contact: Bob Kiefer, Spectral Dynamics, P.O. Box 671, San Diego, CA 92112 - (714) 268-7100.

VIBRATION CONTROL

Dates: September 29 - October 3, 1980

Place: Pennsylvania State University

Objective: This seminar will be of interest and value to engineers and scientists in industry, government, and education. Topics for consideration include dynamic mechanical properties of viscoelastic materials; structural and constrained-layer damping; isolation of machinery vibration from rigid and nonrigid substructures; isolation of impact transients; reduction of vibration in beams, plates, shells, periodic structures, stiffened plates, and rings and ring segments; and characteristics of multi-resonant vibrators. Each student will receive bound lecture notes and copies of six textbooks for his permanent reference.

Contact: Professor John C. Snowdon, Seminar Chairman, Applied Research Laboratory, Pennsylvania State University, P.O. Box 30, State College, PA 16801.

OCTOBER

VIBRATION TESTING

Dates: October 6-9, 1980

Place: San Diego, California

Objective: Topics to be covered are: exciters, fixtures, transducers, test specifications and the latest computerized techniques for equalization, control, and protection. Subjects covered include dynamics and dynamic measurements of mechanical systems, vibration and shock specifications and data generation. Demonstrations are given of sine random and shock testing and of how test specifications are met.

Contact: Bob Kiefer, Spectral Dynamics, P.O. Box 671, San Diego, CA 92112 - (714) 268-7100.

SCALE MODELING IN ENGINEERING DYNAMICS

Dates: October 20-24, 1980

Place: San Antonio, Texas

Objective: The course will begin with a drop test demonstration of damage to model and prototype cantilever beams made from different materials. These tests help to introduce the concepts of similarity and of physical dimensions which are preliminary to any model analysis. Formal mathematical techniques of modeling will then be presented including the development of scaling laws from both differential equations and the Buckingham Pi Theorem. A number of sessions then follow wherein the instructors present specific analyses relating to a variety of dynamic vibrations and transient response problems. The problems are selected to illustrate the use of models as an analysis tool and to give examples of variations on different modeling techniques. Types of problems presented include impact, blast, fragmentation, and thermal pulses on ground, air and floating structures.

Contact: Wilfred E. Baker, Southwest Research Institute, 6220 Culebra Road, P.O. Box 28510, San Antonio, Texas 78284 - (512) 684-5111, Ext. 2303.

DIGITAL SIGNAL PROCESSING

Dates: October 21-23, 1980

Place: Atlanta, Georgia

Objective: The mathematical basis for the fast Fourier transform calculation is presented, including frequency response, impulse response, transfer functions, mode shapes and optimized signal detection. Convolution, correlation functions and probability characteristics are described mathematically and each is demonstrated on the Digital Signal Processor. Other demonstrations include spectrum and power spectrum measurements; relative phase measurements between two signals; and signal source location.

Contact: Bob Kiefer, Spectral Dynamics, P.O. Box 671, San Diego, CA 92112 - (714) 268-7100.

NOVEMBER

MACHINERY VIBRATION IV

Dates: November 11-13, 1980

Place: Cherry Hill, New Jersey

Objective: Lectures and demonstrations on vibration measurement rotor dynamics and torsional vibration are scheduled. General sessions will serve as a review of the technology; included are the topics of machine measurements, modal vibration analysis, and vibration and noise. The rotor dynamics sessions will include: using finite element, transfer matrix, and nonlinear models; vibration control including isolation, damping, and balancing. The sessions on torsional vibration feature fundamentals, modeling measurement and data analysis, self-excited vibrations, isolation and damping, transient analysis, and design of machine systems.

Contact: Dr. Ronald L. Eshleman, Vibration Institute, 101 W. 55th St., Suite 206, Clarendon Hills, IL 60514 - (312) 654-2254/654-2053.

NEWS BRIEFS

news on current and Future Shock and Vibration activities and events

1980 SAE AEROSPACE CONGRESS AND EXPOSITION

The SAE (Society of Automotive Engineers) will celebrate its 75th Anniversary during the 1980 SAE Aerospace Congress and Exposition at the Los Angeles Convention Center, October 13-16, 1980. The Aerospace Congress will include a number of special events and features highlighting the Diamond Jubilee of the Society. As part of this celebration, the SAE G-5 Committee on Aerospace Shock and Vibration is sponsoring two sessions on "Recent Experiences and Advances in Dynamic Testing and Analysis."

For further information, contact: Roy W. Mustain, Rockwell SSG, AB97, 12214 S. Lakewood Blvd., Downey, CA 90241.

AIAA DYNAMICS SPECIALISTS CONFERENCE

Announcement and Call for Papers

An AIAA Dynamics Specialists Conference will be held at the Sheraton-Atlanta Hotel, Atlanta, Georgia, April 9-10, 1981, immediately following the AIAA/ASME/ASCE/AHS 22nd Structures, Structural Dynamics, and Materials (SDM) Conference to be held April 6-8, 1981.

Presentations in the following areas are desired: unsteady aerodynamics; flutter and static aeroelasticity; structural optimization with aeroelastic constraints; composite structures in an aeroelastic environment; payload and aircraft loads; new ground test methods; analytical and experimental modeling; new computational tools and methods; control system-structure interaction; acoustic-structure interaction; nonlinear problems; rotary wing problems; and non-aerospace applications.

Selection of papers will be based on extended abstracts of approximately 1000 words with sketches of proposed key figures or full papers. Six copies of each abstract or full paper should be submitted by August 1, 1980, to the Technical Program Chairman:

Hermann J. Hassig
Flutter & Dynamics Department, 76-12
Lockheed-California Company
Burbank, California 91520
(213) 847-2241

The Conference General Chairman to whom inquiries may be directed is: Dr. Robert M. Laurenson, McDonnell Douglas Astronautics Company, P.O. Box 516, St. Louis, Missouri 63166 - (314) 232-1003.

AIAA/ASME/ASCE/AHS 22nd STRUCTURES, STRUCTURAL DYNAMICS, AND MATERIALS CONFERENCE

Announcement and Call for Papers

The 22nd Structures, Structural Dynamics, and Materials (SDM) Conference, sponsored by the American Institute of Aeronautics and Astronautics, the American Society of Mechanical Engineers, the American Society of Civil Engineers, and the American Helicopter Society, will be held at the Sheraton-Atlanta Hotel, Atlanta, Georgia, April 6-8, 1981. A two-day AIAA Dynamics Specialists Conference will follow the SDM Conference on April 9 and 10, 1981, which all SDM registrants may attent without paying an additional registration fee.

The SDM Conference will not have a single theme, but rather will be organized into sessions in the areas of Structures, Structural Dynamics, Materials, and Design Engineering. Emphasis will be on submitted papers reporting recent accomplishments and research in progress. These topics are not meant to be all inclusive, but to illustrate the wide range of subjects to be included in the conference. Thus papers are solicited in any other area of recent advancement in the areas mentioned.

Selection of papers will be based on an abstract of approximately 1000 words and key figures, or the complete paper, which must be submitted by August 1, 1980. Six copies of each abstract (or paper) should be sent to the Technical Program Chairman:

Ben K. Wada
Bldg. 157, Room 507
Jet Propulsion Laboratory
4800 Oak Grove Drive
Pasadena, California 91103
(213) 354-3600
FTS 792-3600

Inquiries concerning the 22nd SDM Conference should be directed to the Conference General Chairman: Dr. Robert M. Laurenson, McDonnell Douglas Astronautics Company, P.O. Box 516, St. Louis, Missouri 63166 - (314) 232-1003.

26TH INTERNATIONAL GAS TURBINE CONFERENCE AND EXHIBIT
Announcement and Call for Papers

The 26th International Gas Turbine Conference and Exhibit will be held March 8-12, 1981 in the Albert Thomas Convention Center, Houston, Texas. This conference, sponsored by the Gas Turbine Division of ASME, has become an international forum for the interchange of gas turbine technology and product information.

Papers are invited concerning all aspects of gas turbine component and engine technology including research and development, system concepts, applications and operational experience. Papers of potential interest to gas turbine users are particularly encouraged. Authors wishing to submit a paper should forward an abstract to the appropriate Gas Turbine Division Technical Committee or directly to the Program Chairman: Dr. David A. Nealy (U29A), Detroit Diesel Allison Div., General Motors Corporation, P.O. Box 894, Indianapolis, IN 46206 - (317) 243-5467.

Offers of papers, with abstract, should be received by June 1, 1980. The complete manuscript must be received by the Session Organizer or Technical Committee Chairman no later than September 1, 1980. All papers submitted will be reviewed in accordance with established ASME Gas Turbine Division policy and procedures.

INSTITUTE OF ENVIRONMENTAL SCIENCES' 27th ANNUAL TECHNICAL MEETING
Announcement and Call for Papers

"Emerging Environmental Solutions for the Eighties" will be the theme of the Institute of Environmental Sciences' 27th Annual Technical Meeting to be held May 4-7, 1981 at the Marriott Hotel, Los Angeles, California.

The 1981 theme, "Emerging Environmental Solutions for the Eighties", brings together the various interrelated disciplines represented by the Institute to:

- summarize the progress to date;
- establish the current state-of-the-art;
- define interrelationships, and
- project the next decade's technology needs and resources.

The principle issues and concerns of the next decade include electronic and mechanical hardware reliability and acquisition, energy effects and their associated economics, ecology, contamination, and environmental regulations. Electronic and mechanical hardware reliability, acquisition, and life cycle solutions require increased involvement by the environmental science disciplines. This is especially true in governmental projects and will require new and unique solutions.

The sessions will concentrate on the following technology issues:

Environmental Stress Impact on Hardware Life Cycle - Principle Issues - Present and Future:

- Environmental Specifications and Standards
- Environmental Design Integration
- Environmental Analyses: Resources, Data Base and Methods
- Environmental Test
- Special Problems - Stress Screening and Micro Environments: Key Interrelationships, Combined Environments: Benefits vs. Drawbacks, and Dynamics and Statics: Mechanical and Thermal

Environmental Engineering Methods and Technology - Challenges and Emerging Technology:

- Challenges - Modal Analysis Testing: Controversy and Utility; Low-Cost Vibration Testing; Low-Cost Acoustic Testing; and Reliability Testing: Is It Worth It?
- Emerging Technology - Environmental Reliability Modeling; Successful Test Tailoring; Instrumentation: Novel Applications and Problem Solutions; Climatics: New Philosophies and Expanded Applications; and Digital Control and Processing: New Applications and Capabilities

Technical papers are welcome in these and related areas. Since many papers will be invited, it will be necessary that abstracts be submitted by October 1, 1980 to ensure consideration. Recommendations for session chairmen and panel moderators are also welcome. Mail abstract to the 1981 Technical Program Chairman:

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Baltimore, Maryland 21203
(301) 765-6179

ABSTRACTS FROM THE CURRENT LITERATURE

Copies of articles abstracted in the DIGEST are not available from the SVIC or the Vibration Institute (except those generated by either organization). Inquiries should be directed to library resources. Government reports can be obtained from the National Technical Information Service, Springfield, VA 22151, by citing the AD-, PB-, or N- number. Doctoral dissertations are available from University Microfilms (UM), 313 N. Fir St., Ann Arbor, MI; U.S. Patents from the Commissioner of Patents, Washington, D.C. 20231. Addresses following the authors' names in the citation refer only to the first author. The list of periodicals scanned by this journal is printed in issues 1, 6, and 12.

ABSTRACT CONTENTS

MECHANICAL SYSTEMS

ROTATING MACHINES

(Also see Nos. 1552, 1553, 1587, 1654
1658, 1694, 1698, 1703, 1728, 1734)

80-1478

Identification of Noise Sources in FC Centrifugal Fan Rotors

D Raj

Ph.D Thesis, Tennessee Technological Univ., 263 pp (1978)
UM 8004103

Key Words: Fans, Noise generation, Noise source identification, Noise reduction, Design techniques

The sources of broadband noise in forward curved (FC) centrifugal fan rotors were studied using a 10.6-inch diameter fan. This study showed that the separated flow over the blade suction surface was the major broadband noise source.

80-1479

Noise and Performance of Automotive Cooling Fans

R.C Mellin

Fluid Dynamics Dept., General Motors Res Labs., Warren, MI, SAE Paper No 800031, 36 pp, 80 figs, 14 refs

Key Words: Fans, Cooling systems, Noise generation, Noise reduction, Design techniques

An investigation of various engine-cooling fan designs shows that a judicious use of both noise and performance characteristics is important in selecting the best fan design for a given application. These studies show that decreasing tip clearance, decreasing pitch angle, and increasing chord at a given solidity will increase fan efficiency, while decreasing tip clearance, optimizing pitch angle, optimizing camber, and optimizing solidity will reduce fan noise.

80-1480

Flow in a Whirling Rotor Bearing

J. Brindley, L. Elliott and J.T. McKay

Dept of Applied Mathematical Studies, Univ of Leeds, Leeds, LS2 9JT, UK, J. Appl Mech., Trans. ASME, 46 (4), pp 767-771 (Dec 1979) 6 figs, 11 refs

Key Words: Rotors (machine elements), Bearings, Rotor bearings, Cylinders, Whirling, Fluid-induced excitation

The flow in the annular region between two infinitely long parallel circular cylinders was examined, when the axis of the inner cylinder travels in a circular whirl orbit about the axis of the outer cylinder. One or both of the cylinders rotate with constant angular velocity. The analysis is restricted to small values of both clearance ratio and modified Reynolds number. Corrections for curvature and inertia effects are included using an expansion in terms of the above parameters. The resultant forces exerted by the fluid on the cylinders are calculated for the cases when the bearing clearance is completely filled with lubricant and also when cavitation occurs.

80-1481

Thermally Induced Whirl of a Rigid Rotor on Hydrodynamic Journal Bearings

E.R. Maki and H.A. Ezzat

General Motors Res Labs., Warren, MI 48090, J Lubric Tech., Trans ASME, 102 (1), pp 8-14 (Jan 1980) 7 figs, 3 tables, 16 refs

Key Words: Rotors (machine elements), Rigid rotors, Bearings, Journal bearings, Rotor-bearing systems, Whirling, Thermal excitation

An experimental study was conducted on rigid rotors supported on 360° circumferentially grooved journal bearings. The effect of bearing clearance, lubricant inlet temperature, and supply pressure on whirl instability was examined. The experimental results indicate that self-excited whirl exists whenever the lubricant inlet temperature is higher than that of the bearing surface. On the other hand, when the bearing temperature is higher than the lubricant inlet temperature, whirl does not occur even at rotor speeds considerably higher than the instability threshold predicted by isothermal hydrodynamic theory. This thermally-induced whirl-phenomenon has not been reported elsewhere and is documented in this paper.

80-1482

Stability of a Rotor Partially Filled with a Viscous Incompressible Fluid

S.L. Hendricks and J.B. Morton

Dept. of Mech. and Aerospace Engrg., Univ. of Virginia, Thornton Hall, Charlottesville, VA 22901, J. Appl. Mech., Trans. ASME, 46 (4), pp 913-918 (Dec 1979) 8 figs, 11 refs

Key Words: Stability, Rotating structures, Rotors (machine elements), Cylindrical shells, Fluid-filled containers, Viscous damping

A hollow circular cylinder rotating with constant angular velocity and partially filled with a viscous incompressible fluid has been analyzed for stability. The analysis can be extended to apply to many different rotor geometries. The results of this analysis predict that over a range of operating speeds, the system is unstable. The extent of this unstable region is determined by the system parameters. The interplay between viscosity of the fluid and damping on the rotor is especially important in determining stability boundaries. A parametric study is presented for a rotor modeled as a cup in the middle of a symmetrically supported massless shaft. The rotor is subject to a linear spring and a linear damper. Rotor unbalance, gravity, and axial effects are considered negligible.

80-1483
Excitation of Rotationally Periodic Structures
S J Wildheim
STAL LAVAL Turbin AB, Department Lb, S-612 20 Finspong, Sweden, J Appl Mech., Trans ASME, 46 (4), pp 878-882 (Dec 1979) 7 figs, 3 refs

Key Words: Rings, Periodic structures, Resonant frequencies

This paper elucidates the conditions under which a rotating force distribution is able to excite resonance vibrations in a rotationally periodic structure which is stationary in space. The force is assumed to rotate about the axis of structural symmetry. A rotationally periodic structure consists of a finite number of identical substructures forming a closed ring. These types of structures are met with in many applications, e.g., turbomachinery bladings, circular saw blades, gear-wheels, etc.

RECIPROCATING MACHINES

(Also see No. 1734)

80-1484
Diesel Engine Sound Reduction by Dynamic Structural Modeling
M E Moncelle
Caterpillar Tractor Co., SAE Paper No. 800409, 12 pp, 9 figs, 2 tables, 12 refs

Key Words: Engines, Diesel engines, Noise reduction, Mathematical models, Experimental data

A procedure for reducing diesel engine sound levels by combining analytical models and test data is presented. Four previously analyzed elements: structure modal characteristics, forcing functions, dynamic response, and acoustical radiation were combined to accurately predict changes in diesel engine sound levels due to structural modifications.

80-1485
High Frequency Vibration Transmission Through the Moving Parts of an Engine
R.G. DeJong and N.E. Parsons
Cambridge Collaborative, Inc., Cambridge, MA, SAE Paper No. 800405, 12 pp, 9 figs, 6 refs

Key Words: Engines, Diesel engines, Engine vibration, Mathematical models

A combustion model has been developed for a 4 cylinder, direct injection, naturally aspirated, diesel engine. The model is based on the vibration transmission characteristics of various components of the engine structure which relate internal forces to the vibration of the external, radiating surfaces. The model is constructed from measurements of the vibration characteristics of the individual engine components when disassembled. The assumption that this model is valid for the running engine is investigated particularly for the moving parts of the engine. The vibration transmission has been measured during the operation of the engine and compared to that predicted by the model.

80-1486
Analysis Techniques of Combustion Noise and Vibrations in Diesel Engines
A Alpini, M Busso, G. Ruspa, and G Turino
Fiat Res Ctr., S p A., Orbassano, Italy, SAE Paper No 800406, 16 pp, 17 figs, 12 refs

Key Words: Engines, Diesel engines, Noise-source identification, Combustion noise

An approach based on complementary techniques is presented, by which the combustion noise is investigated and separated from other vibrational phenomena in a running engine, analyzing the evolution of the time history as a func

tion of engine speed and load, as well as the correlation between pressure cycles and noise. In fact, a combination of techniques, such as near field intensity measurements, multiple and partial coherence methods, time-domain signal processing, can be successfully applied in order to improve the required discrimination.

80-1487

Analysis of Piston Slap-Induced Noise and Assessment of Some Methods of Control in Diesel Engines

S.D. Haddad and D.A. Howard

Loughborough Univ. of Tech., SAE Paper No. 800-517, 16 pp, 11 figs, 4 refs

Key Words: Engines, Diesel engines, Noise generation, Noise reduction

A theoretical analysis of the diesel engine piston slap dynamics predicts some optimum piston design features for low piston slap-induced noise related to the estimated mechanical efficiency of the engine.

80-1488

Noise of Diesel Engines Under Transient Conditions

H.E. Head and J.D. Wake

Lucas CAV Ltd., Acton, SAE Paper No. 800404, 12 pp, 9 figs, 7 refs

Key Words: Engines, Diesel engines, Engine noise, Noise generation

This paper shows that the increase in diesel engine noise originating from the combustion process is due to the lower temperature of the air charge. It is also shown how mechanical noise from piston slap increases under acceleration conditions.

80-1489

Combustion Noise Variability on a DI Diesel Engine

D.F. Kabele

John Deere Product Engrg. Ctr., Waterloo, IA, SAE Paper No. 800403, 8 pp, 4 figs, 3 refs

Key Words: Engines, Diesel engines, Engine noise, Harmonic analysis

Cylinder pressure excitation is a major source of diesel engine noise. A data acquisition system for obtaining harmonic analysis of cylinder pressure is described. Variability of cylinder pressure harmonic analysis is investigated with respect to cycle-to-cycle, cylinder-to-cylinder, and test-to-test variations. Cycle-to-cycle variation was found to have the largest magnitude. Recommendations for averaging data are included.

80-1490

The Effect of Noise Legislation on Vehicle Diesel Engine Design

P.E. Waters

Dept. of Transport, Vehicle Standards and Engrg. Div., UK, SAE Paper No. 800401, 16 pp, 12 figs, 1 table, 46 refs

Key Words: Engines, Diesel engines, Engine noise, Trucks, Noise reduction, Regulations

From the basic characteristics of truck diesel engine noise, a philosophy of noise control is developed and practical means of achieving the desired noise control are discussed.

80-1491

Noise from Vibration

D. Anderton and N.A. Halliwell

I.S.V.R., Univ. of Southampton, UK, SAE Paper No. 800407, 16 pp, 16 figs, 1 table, 14 refs

Key Words: Engines, Diesel engines, Engine vibration, Noise generation, Measuring instruments

The noise produced by vibrating surfaces is discussed with particular application to diesel engines and their component parts. The measurement and prediction of engine noise balances using the surface vibration technique is described and the variation of engine block vibration with engine type and speed illustrated. Some measured radiation ratio's for engine surfaces and components are given. Finally a method for measuring surface vibration on diesel engines using a laser doppler velocimeter is described.

80-1492

In Search of Origins of Engine Noise - An Historical Review

T. Priede

Inst. of Sound and Vibration Res., Univ. of Southampton, UK, SAE Paper No. 800534, 36 pp, 33 figs, 120 refs

Key Words: Internal combustion engines, Noise source identification

The development of the internal combustion engine noise generation is discussed from the very early subjective assessments to the present day sophisticated experimental and theoretical analyses.

80-1493

Engine Noise Due to Mechanical Impacts at Pistons and Bearings

N. Lalor, E.C. Grover, and T. Priede

Inst. of Sound and Vib. Res., Univ. of Southampton, UK, SAE Paper No. 800402, 12 pp, 7 figs, 6 refs

Key Words: Engines, Engine noise, Noise generation

The noise of engines of different size, duty and combustion system are compared. Measured differences, not consistent with combustion charges, are analyzed in detail and these differences are shown to be the result of mechanical impacts. Results suggest that the kinetic energy of impact is not the only significant parameter influencing mechanical noise, and in the general case the magnitude of the force accelerating a component across a clearance must also be considered. The analysis shows that the dominant parameters affecting the magnitude of the impact change with speed and size of engine and offers an explanation for the apparent discrepancies observed in some previously recorded data.

80-1494

Engine Noise Reduction by Structural Study of Cylinder Block

I Nagayama, Y Araki, K. Kakuta, and Y. Usuba

Nissan Motor Co., Ltd., Yokohama, Japan, SAE Paper No 800441, 12 pp, 14 figs, 4 tables, 5 refs

Key Words: Engine noise, Noise reduction

A structural study of the cylinder block was made using a 4-cylinder, 1,800 cc gasoline engine with an aim toward reducing engine noise. From the relationship between cylinder block vibration and radiated noise, and also the principal component modes of noise and vibration, a trial cylinder block was built into an engine after examination by the impulse excitation method and holography. As the result of testing it in running condition, the noise of the engine proper was reduced 2.5 dB(A) with a weight increase of about 3 percent.

80-1495

Noise Reduced by Structural Studies

I. Nagayama, Y. Araki, K. Kakuta, and Y. Usuba

Nissan Motor Co. Ltd., Auto Engr. (SAE), 88 (2), pp 79-83 (Feb 1980) 6 figs

Key Words: Engine noise, Motor vehicle noise, Noise reduction, Design techniques

Surface vibration and radiated noise from a cylinder block of an automobile engine were examined and correlated. Natural vibration modes such as torsional bending and axial bearing deformation were found to be principal components. Finite element methods, impulse excitation, holography, and operational testing revealed that achieving high frequency and low amplitude for the natural vibrations analytically was satisfactory. A modified block was then simulated via finite element means -- and a model tested. With only a 3% weight penalty, radiated noise was decreased about 2 dB(A), providing encouragement for extending the method to other engine parts.

POWER TRANSMISSION SYSTEMS

(See No. 1589)

METAL WORKING AND FORMING

(Also see No. 1727)

80-1496

Testing and Design Techniques Cure Machine Tool Problems

SDRC Newsletter, 11 (1), pp 3-7 (Feb 1980) 4 figs

Key Words: Machine tools, Chatter, Vibration control, Dynamic vibration absorption (equipment), Vibration absorption (equipment)

A case history for the solution of machine tool chatter problem is presented. It describes the operational and artificial excitation tests performed, lists the insights gained, and suggests several solutions. The option of installing a dynamic absorber on the fixture (workpiece) side of the machine was chosen.

80-1497

On the Damping Effect in Surface Plastic Deformation

P.G. Balyura

Allerton Press, Inc., New York, NY, In: Its Soviet Aeron., 21 (2), pp 103-106 (1978), Engl. transl. from Izv. Vyssh. Ucheb. Zaved. Aviats. Tekh., USSR, 21 (2), pp 126-129 (1978), For primary document, see N80-11002, Avail: Allerton Press, Inc., 150 Fifth Ave., New York, NY 10011, $45.00

Key Words: Metal working, Vibratory techniques, Damping effects

Vibration theory is used to examine two techniques for metal working by surface plastic deformation which are illustrated by two mechanical models. It is shown that in the second metal working technique the indentor vibrations can be minimized by reducing its period and amplitude.

80-1498

Dynamic Acceptance Test for Machine Tools Based on a Nonlinear Stochastic Model

M. Samaha and T.S. Sankar

Dept. of Mech. Engrg., Concordia Univ., Montreal, Quebec, Canada, J. Mech. Des., Trans. ASME, 102 (1), pp 58-63 (Jan 1980) 8 figs, 18 refs

Key Words: Machine tools, Mathematical models, Stochastic processes, Cutting

A nonlinear two-degree-of-freedom mathematical model of a general machine tool is considered for describing the responses in translational and rotational modes under the action of the actual randomly fluctuating metal cutting forces in a Gaussian, wide band form. The response process is determined by the Fokker-Planck technique for the simplified case and also by the statistical linearization method for the general case to establish accuracy of the results obtained.

MATERIALS HANDLING EQUIPMENT

(Also see No. 1526)

80-1499

Study of a Vibratory Feeder with Repulsive Surface Which has Directional Characteristic

S. Okabe and Y. Yokoyama

Faculty of Engrg., Kanazawa Univ., Kanazawa, Japan, J. Mech. Des., Trans. ASME, 102 (1), pp 94-101 (Jan 1980) 12 figs, 9 refs

Key Words: Vibrators (machinery), Materials handling equipment

The motion of a particle on a vibratory feeder whose track has directional characteristic in repulsive motion, e.g., obliquely bristled track or obliquely sliced track is investigated. The equation for predicting the mean conveying velocity is shown and the relations between conveying condition and the mean conveying velocity are analyzed. These relations are illustrated by various diagrams, and the optimum conveying conditions are discussed. The theoretical results are confirmed by experimental studies.

80-1500

Noise Abatement of Sliding Chutes for Metal Stamping Production

M. Loo and E. Rivin

Ford Motor Co., SAE Paper No. 800493, 12 pp, 13 figs, 1 table, 3 refs

Key Words: Materials handling equipment, Metal working, Noise reduction

Identification of the noise generating mechanisms of gravity action and vibrator stimulated sliding chutes has resulted in the development of practical and effective noise abatement treatments for both. Test results from both types of equipment are shown.

80-1501

Noise Abatement of Vibratory Feeders

E. Rivin

Ford Motor Co., SAE Paper No. 800496, 12 pp, 11 figs, 2 refs

Key Words: Materials handling equipment, Vibratory techniques, Noise generation, Noise reduction

Three principal noise-generating mechanisms were identified in the vibratory feeder as structural vibrations, interaction between the conveyed parts and the track surface and radiation from the bowl cavity. Treatment of the track surface based on theoretical analysis of the vibration-stimulated conveyance, structural damping treatment of the bowl and "see through, load through, reach through" acoustical screen

have been developed. These treatments lead to 20-25 dBA reduction of the sound pressure level accompanied by substantial reduction of part delivery time.

STRUCTURAL SYSTEMS

BRIDGES

(Also see Nos. 1603, 1656, 1745, 1746)

80-1502

Aerodynamic Response of Long H-Sections

F.J. Maher and L.E. Wittig
Virginia Polytechnic Inst. and State Univ., Blacksburg, VA, ASCE J. Struc. Div., 106 (ST1), pp 183-197 (Jan 1980) 9 figs, 16 refs

Key Words: Bridges, Aerodynamic characteristics, Vibration response, Wind tunnel tests, Vibration tests, Wind-induced excitation

Section models of several long H-section members of the Commodore Barry Bridge were tested in wind tunnels for aerodynamic coefficients and for vibration response when supported in a three degree-of-freedom mounting. Vibration testing was carried out in both smooth and turbulent flow. Comparisons were made with the response of an aeroelastic model.

BUILDINGS

(Also see Nos. 1598, 1600, 1736, 1745, 1746)

80-1503

Time Variations of Structural Properties During Strong Ground Shaking

F.E. Udwadia and N. Jerath
Univ. of Southern California, Los Angeles, CA, ASCE J. Engr. Mech. Div., 106 (EM1), pp 111-121 (Feb 1980) 5 figs, 8 refs

Key Words: Ground motion, Seismic response, Multistory buildings, Buildings, Mathematical models

After modeling the system as a linear time variant single degree-of-freedom system, a systematic methodology for the analysis of such behavior from a knowledge of the basement and roof records has been developed. By utilizing such noisy records, and incorporating any data available from pre- and post-earthquake vibration tests, the time varying coefficients of the differential equation, used to model the structure, have been identified using a minimum variance sequential filter.

80-1504

Current and Tentative Seismic Design Provisions for Buildings: Preliminary Comparisons

J.D. Prendergast and W.E. Fisher
Construction Engineering Res. Lab. (Army), Champaign, IL, Rept. No. CERL-TR-M-270, 57 pp (Aug 1979)
AD-A075 204/8

Key Words: Buildings, Seismic design

This report compares current and tentative seismic design provisions for two types of buildings: Letterman Army Hospital, an existing 10-story, reinforced concrete building located in the Presidio of San Francisco, CA, whose design was based upon the 1964 Uniform Building Code (UBC), and a three-story, ductile moment resistant steel frame building located in a region of high seismicity and designed as an essential building.

80-1505

Revised Procedure for Estimating Along-Wind Response

E. Simiu
Center for Building Tech., National Bureau of Standards, Washington, D.C., ASCE J. Struc. Div., 106 (ST1), pp 1-10 (Jan 1980) 6 figs, 8 refs

Key Words: Buildings, Wind-induced excitation, Mathematical models, Monte Carlo method

A revision of a procedure for calculating the along-wind response of tall buildings is presented. It incorporates recent improvements in the modeling of mean wind profiles and of turbulence intensity, includes a correction in the Monte Carlo integration algorithm employed to obtain the rms values of the fluctuating response and thus results in more accurate values of the calculated along-wind response, and is simpler to use. A numerical example is given illustrating the use of the procedure.

80-1506

Santa Barbara Earthquake of August 13, 1978: Field Data Report

R.A. Philbrick and G.N. Owen

URS/John A. Blume and Associates, San Francisco, CA, 100 pp (Aug 1979) 84 figs, 3 tables

JAB-00099-124

Key Words: Buildings, Earthquake damage, Damage prediction

A field study was conducted of the damage inflicted on structures in the Greater Santa Barbara area by a magnitude-5.1 earthquake. The study was undertaken to determine the general nature and extent of damage to all types of structures. Particular attention was given to the damage sustained by mobile homes because the damage to these structures during the earthquake was more extensive than expected.

80-1507

Response of Ten Story, Reinforced Concrete Model Frames to Simulated Earthquakes

H. Cecen

Ph.D. Thesis, Univ. of Illinois at Urbana-Champaign, 353 pp (1979)

UM 8004149

Key Words: Buildings, Multistory buildings, Reinforced concrete, Seismic excitation, Experimental data, System identification techniques

The object of this research was to study both elastic and inelastic response of reinforced concrete structures subjected to strong earthquake excitations. Various aspects of the observed response were studied and interpreted. Several analytical methods and structural idealizations were evaluated by comparing the response calculated by them with the observed response of the test structures.

80-1508

Experimental Study of Frame-Wall Interaction in Reinforced Concrete Structures Subjected to Strong Earthquake Motions

D.P. Abrams

Ph.D. Thesis, Univ. of Illinois at Urbana-Champaign, 400 pp (1979)

UM 8004118

Key Words: Buildings, Multistory buildings, Reinforced concrete, Seismic response, Experimental data

The overall objective of this experimental study was to develop a better understanding of the response of reinforced concrete structures subjected to earthquake motions, and to investigate improved methods of analysis for design of structures in linear and nonlinear ranges of response.

TOWERS

(See Nos. 1618, 1619, 1620, 1621)

FOUNDATIONS

80-1509

Design Analysis of Liquid Metal Pipe Supports

L.L. Margolin and F.R. LaSalle

Hanford Engrg. Dev. Lab., Richland, WA, HEDL-SA-1771, US National Congress on Pressure Vessels and Piping, San Francisco, CA, USA, June 25, 1979, CONF-790615-19, 15 pp (Feb 1979)

Key Words: Supports, Pipes (tubes), Mathematical models, Natural frequency, Stiffness, Design techniques

Design guidelines pertinent to liquid metal pipe supports are presented. The numerous complex conditions affecting the support stiffness and strength are addressed in detail. Topics covered include modeling of supports for natural frequency and stiffness calculations, support hardware components, formulas for deflection due to torsion, plate bending, and out-of-plane flexibility. A sample analysis and a discussion on stress analysis of supports are included.

80-1510

Analysis of Piping Systems with Nonlinear Supports Subjected to Seismic Loading

D.A. Barta

Hanford Engrg. Dev. Lab., Richland, WA, HEDL-SA-1769, U.S. National Congress on Pressure Vessels and Piping, San Francisco, CA, USA, June 25, 1979 CONF-790615-18, 23 pp (Mar 1979)

Key Words: Supports, Pipes (tubes), Seismic response

An analytical study of effects of nonlinearities in piping supports on response to seismic excitation is presented. Re-

sponse calculations for simplified single degree of freedom nonlinear models are used to illustrate sensitivity to stiffness variations, lost motion and impact damping. Seismic responses of typical spans of various sizes of piping supported by both linear and nonlinear constraints are compared to assess the support load magnifications due to impacting. The idealized nonlinear piping support models are integrated with a finite element model of a large piping system. Time domain seismic responses of the nonlinear piping system are compared to loads determined by a standard linearized seismic response spectra technique.

80-1511

Seismic Design Input for Secondary Systems

M.P. Singh

Virginia Polytechnic Inst. and State Univ., Blacksburg, VA, ASCE J. Struc. Div., 106 (ST2), pp 505-517 (Feb 1980) 6 figs, 2 tables, 10 refs

Key Words: Floors, Seismic response spectra, Equipment, Machine foundations, Seismic design, Stochastic processes

A comprehensive procedure based on stochastic principles is presented for definition of seismic design inputs for light equipment and other secondary systems. This procedure does not use the spectrum-consistent time history as seismic input for generation of floor spectra curves.

80-1512

Recommendations for Grouting Machinery

W.H. Whittaker

Unisorb Machinery Installation Systems, Jackson, MI, Plant Engr., pp 115-118 (Jan 24, 1980) 6 figs

Key Words: Machinery vibration, Machine foundations

The grouting of machine base plates and bearing plates, and of anchoring/alignment equipment to a foundation are described. Successful installations requiring proper grout selection, good application, foundation preparation, good forming methods, and careful attention to the actual application of the grouting material are described.

UNDERGROUND STRUCTURES

(See Nos. 1626, 1627)

HARBORS AND DAMS

80-1513

Los Angeles and Long Beach Harbors Model Study: Report 6. Resonant Response of the Modified Phase I Plan

D.G. Outlaw

Hydraulics Lab., Army Engineer Waterways Experiment Station, Vicksburg, MS, Rept. No. WES-HL-75-4-6, 139 pp (Aug 1979)

AD-A075 728/6

Key Words: Harbors, Water waves, Resonant response, Model testing

A study of harbor resonance due to long-period wave excitation was conducted in Los Angeles and Long Beach Harbors hydraulic model for the Modified Phase I improvement plan and compared with resonant response for existing conditions. Proposed improvements for the Modified Phase I plan included dredging of navigation channels and an associated landfill of approximately 200 acres in the Port of Los Angeles, and an Outer Harbor Oil Terminal in the Port of Long Beach. Comparisons of model data for existing conditions and the proposed plan indicated that resonant modes of oscillation in the existing harbor berthing areas were not substantially altered.

80-1514

Fluid-Structure Interaction in Morison's Equation for the Design of Offshore Structures

P.R. Fish, R.B. Dean, and N.J. Heaf

Atkins Res. and Dev., Woodcote Grove, Ashley Rd., Epsom, Surrey, UK, Engr. Struct., 2 (1), pp 15-26 (Jan 1980) 12 figs, 7 tables, 12 refs

Key Words: Off-shore structures, Interaction: structure-fluid, Mathematical models, Computer programs, Damping effects

A simplified model of a steel jacket structure is used in a nonlinear time history dynamic analysis with a view to examining the influence of interaction damping. After a brief literature review, the theory of Morison's equation is discussed. A computer program, PLATDYN, is then described which computes the dynamic response of a structure in various sea states. The method of representing the full structure by a reduced number of members is explained before the results of the analysis are presented. Finally, a procedure is proposed which provides an economic method of including the effects of interaction damping in the design of offshore structures.

CONSTRUCTION EQUIPMENT

(See No. 1568)

POWER PLANTS

(Also see Nos. 1602, 1611)

80-1515

Construction and Design of Large Cooling Towers

W. Zerna and I. Mungan

Ruhr-Universität Bochum, Institut f. Konstruktiven Ingenieurbau, Lehrstuhl 1, Bochum, West Germany, ASCE J. Struc. Div., 106 (ST2), pp 531-544 (Feb 1980) 11 figs, 5 tables, 13 refs

Key Words: Towers, Cooling towers, Vibration response, Shells, Stiffened shells

Large natural-draft cooling towers are required for dry-type cooling of power plants having high capacity. Stiffening rings which can be built easily after slight modification of the existing climbing formwork are described.

80-1516

Non-Linear Oscillations in Wave Power Machines

P.C. Parks and A. Tondl

Royal Military College of Science, Shrivenham, Swindon, SN6 8LA, UK, Intl. Conf. on Nonlinear Oscillations, Proc. of the 8th Institute of Thermomechanics Czech., Acad. Sci., Prague, pp 69-85 (1978) 27 figs, 8 refs

Key Words: Water waves, Wave energy, Electric power generation, Hydroelectric power plants

A review of wave energy research in the United Kingdom is given, with a brief description of some of the more promising wave power machines. Two possible devices which absorb 100% of the energy in an incoming wave train are reviewed using linear theory. Two non-linear problems, conversion of reciprocating to rotary motion using a crank mechanism and direct pumping by a plate which in turn is subjected to forces in the sea, are also investigated.

80-1517

A Case History of a Low Frequency Noise Problem

P.F. Chatterton

Rupert Taylor & Partners Ltd., Noise Control Vib. Isolation, 10 (7), pp 295-298 (Aug/Sept 1979) 5 figs

Key Words: Boilers, Noise reduction, Low frequencies

A case history of a low frequency silencer design for a hospital boiler house is described, which reduces the level of a tonal noise to approximately 30 Hz. The silencer design differs from the conventional side branch resonator type in that the resonating volume surrounds the main duct and that the resonator reactance was chosen outside of the limitations for the side branch resonator theory to be valid. The case also highlights the inadequacy of the existing noise assessment procedures of low frequency noise, particularly where the indoor level is high.

80-1518

Sloshing of Water in Torus Pressure-Suppression Pool of Boiling Water Reactors Under Earthquake Ground Motions

M. Aslam, W.G. Godden, and D.T. Scalise

Lawrence Berkeley Lab., California Univ., Berkeley, CA, Rept. No. LBL-7984, 118 pp (Oct 1979) NUREG/CR-1082

Key Words: Fluid-filled containers, Nuclear reactors, Boiling water reactors, Sloshing, Seismic excitation, Finite element technique, Computer programs, Experimental data

This report presents an analytical and experimental investigation into the sloshing of water in torus tanks under horizontal earthquake ground motions. A general finite element analysis was developed for all axisymmetric tanks and a computer program was written to obtain time-history plots of sloshing displacements of water and dynamic pressures. Tests were carried out on a 1/60th scale model under sinusoidal as well as simulated earthquake ground motions.

VEHICLE SYSTEMS

GROUND VEHICLES

((Also see Nos. 1490, 1560, 1651, 1563, 1566, 1567, 1643, 1671, 1676, 1679, 1693 1707, 1736, 1741, 1742, 1743, 1744)

80-1519

Restraint Systems Comparison in Frontal Crashes Using a Living Animal

M. DeJeammes, R. Biard, R. Quincy, Y. Derrlen, P. Billault, and C. Tisseron
Laboratoire des Chocs et de Biomecanique, ONSER, SAE Paper No. 800297, 20 pp, 18 figs, 8 tables, 16 refs

Key Words: Collision research (automotive), Automobile seat belts, Safety restraint systems, Experimental data, Animal response

To investigate the efficiency of three-point safety belts, a comparative study using a baboon was carried out. The static three-point belt being the reference, the restraint systems were tested in frontal impacts.

80-1520

Aerodynamics of Six Passenger Vehicles Obtained from Full Scale Wind Tunnel Tests

J.R. Hogue
Systems Technology, Inc., Hawthorne, CA, SAE Paper No. 800142, 20 pp, 23 figs, 1 table, 12 refs

Key Words: Automobiles, Aerodynamic loads, Wind tunnel tests

This paper presents the results of aerodynamic measurements made on six full scale vehicles in a large cross section wind tunnel. The vehicles included a sports car, subcompact sedan, intermediate-sized sedan, two vans, and a full-sized station wagon. Criteria for the selection of the wind tunnel facility are described. Aerodynamic data is then presented as non-dimensional lateral and longitudinal coefficients for yaw angles between +40 to −180 degrees. Results are compared to previous model and full scale tests.

80-1521

Surface-Effect Components of Aerodynamic Characteristics of Air-Cushion Vehicle with Ram Pressurization

M.A. Guryanov
Allerton Press, Inc., New York, NY, In: Its Soviet Aeron., 21 (2), pp 10-19 (1978), Engl. transl. from Izv. Vyssh. Ucheb. Zaved. Aviats. Tekh. USSR, 21 (2), pp 17-29 (1978), For primary document, see N80 11002, Avail Allerton Press, Inc., 150 Fifth Ave., New York, NY 10011, $45.00

Key Words: Surface effect machines, Aerodynamic characteristics

Results are presented of theoretical studies of the purely surface-effect components of the aerodynamic characteristics of an air-cushion vehicle consisting of a semitunnel of pi-shaped cross section traveling above a ground plane with translational velocity.

80-1522

Experimental Idler Design and Development of Hull Concepts for Noise Reduction in Tracked Vehicles

T.R. Norris, P.E. Rentz, A.G. Galaitsis, R.B. Hare, and S.A. Hammond
Ordnance Engrg. Div., FMC Corp., San Jose, CA, Rept. No. HEL-TM-8-79, 74 pp (June 1979)
AD-A074 484/7

Key Words: Tracked vehicles, Ground vehicles, Suspension systems (vehicles), Noise reduction, Mathematical models

The first phase of this study rank ordered the major noise sources of the M113A1 Armored Personnel Carrier and developed a preliminary mathematical model of the track and suspension system. Vibration-to-noise transfer functions were experimentally derived for inclusion in the model. The present study was designed to capitalize upon those achievements by designing a high compliance idler, and by refining the computer model so that additional precision could be gained and a greater number of parameters varied.

80-1523

Passenger Car Noise Control Measures and Their Effects on Fuel Economy, Weight and Cost

D. Morrison, B.J. Challen, and T. Trella
Ricardo Consulting Engineers, SAE Paper No. 800-439, 24 pp, 18 figs, 3 tables, 9 refs

Key Words: Cars, Noise reduction

Various passenger car practical noise control measures are presented and discussed. Emphasis is placed on the noise control tradeoffs with fuel economy and weight. Both diesel and gasoline powered automobiles were considered. The diesel was of the indirect injection type and a conventional spark ignition engine constituted the gasoline powered type.

80-1524

Side Impacts: A Comparison of Laboratory Experiments and NCSS Crashes

J.W. Melvin, J. O'Day, K.L. Campbell, D.H. Robbins, and D.F. Huelke
Highway Safety Res. Inst., Univ. of Michigan, SAE Paper No. 800176, 12 pp, 3 tables, 2 refs

Key Words: Collision research (automotive), Experimental data

Selected side-impact cases from the National Crash Severity Study were studied to determine similarities and differences between actual crashes and laboratory (sled) crash tests.

80-1525
Lateral Dynamics and Stability of the Skateboard
M. Hubbard
Dept. of Mech. Engrg., Univ. of California, Davis, CA 95616, J. Appl. Mech., Trans. ASME, 46 (4), pp 931-936 (Dec 1979) 8 figs, 6 refs

Key Words: Skateboards, Recreational vehicles, Mathematical models, Stability

The natural lateral dynamic behavior of a skateboard is described in the absence of rider control. The effects of vehicle and rider parameters are investigated and stability criteria are derived in terms of these parameters. It is shown that for certain parameter values a simple one-degree-of-freedom vehicle model predicts a critical speed above which inertia effects can stabilize the roll motion, and that the frequency of roll oscillations is a function of forward speed. Experimental validation of the first theory is included.

80-1526
Noise Abatement of In-Plant Trailers
B. Huang and E. Rivin
Ford Motor Co., SAE Paper No. 800494, 20 pp, 19 figs, 2 tables, 4 refs

Key Words: Trailers, Noise reduction, Materials handling equipment

Noise and dynamic loads associated with in-plant trailers are investigated and abatement techniques are developed.

SHIPS

(Also see Nos 1614, 1699)

80-1527
Reducing the Sound Level of Power Boats
R.T. Larsen
Outboard Marine Corp., SAE Paper No. 800279, 16 pp, 21 figs, 8 tables

Key Words: Boats, Noise reduction, Noise transmission, Noise source identification

This paper presents some techniques for the establishment of attainable sound levels both in and out of a power boat. It delineates techniques that can be used to analyze noise sources and noise transmission paths. The most cost effective selection of materials, devices and designs for the sound level reduction of a power boat are given.

80-1528
Source Level Model for Propeller Blade Rate Radiation for the World's Merchant Fleet
L.M. Gray and D.S. Greeley
Bolt Beranek and Newman, Inc., 50 Moulton St., Cambridge, MA 02138, J. Acoust. Soc. Amer., 67 (2), pp 516-522 (Feb 1980) 14 figs, 13 refs

Key Words: Ships, Noise generation, Propeller noise, Statistical analysis

A model is developed for the acoustic source strength of blade rate line energy produced by single-screw merchant vessels. These source strengths are based on observed cavitation time histories on merchant vessels and on limitations imposed by considerations of propeller design procedures and ship vibration criteria. Relationships are presented for the expected value of the blade rate source strength for ships of different lengths, expressed both as a monopole source strength located at a known depth below a free surface and as a dipole source strength that describes the pressure radiated to the farfield.

80-1529
Transcritical Heave and Pitch Motions in Shallow Water
A. Plotkin
Univ. of Maryland, College Park, MD, J. Ship Res., 24 (1), pp 45-49 (Mar 1980) 4 figs, 6 refs

Key Words: Ships, Water waves

The problem of small heave and pitch motions of a slender ship in shallow water in the transcritical speed range is analyzed. Formulas valid to first order in slenderness are given for the added-mass damping coefficients in terms of the Froude number and moderate values of the reduced frequency.

80-1530
Hydrodynamic Interactions of Ships with Fixed Obstacles
R.W. Yeung and W.T. Tan
Dept. of Ocean Engrg., Massachusetts Inst. of Tech., Cambridge, MA, J. Ship Res., 24 (1), pp 50-59 (Mar 1980) 10 figs, 1 table, 12 refs

Key Words: Ships, Hydrodynamic excitation

The hydrodynamic interactions of a slow-moving vessel with a coastline or an obstacle in shallow water are investigated using slender-body theory. A numerical procedure is developed based on the availability of an "obstacle Green function." For a vessel approaching a side bank at an angle, the theory yields results consistent with the so-called "bank-rejection" phenomenon.

80-1531
The Effects of Varying Ship Hull Proportions and Hull Materials on Hull Flexibility, Bending and Vibratory Stresses
P.Y. Chang
Hydronautics Inc., Laurel, MD, Rept. No. 7715-1, SSC-288, 82 pp (Apr 1979)
AD-A075 477/0

Key Words: Ships, Ship hulls, Natural frequencies

The effect of varying ship proportions and hull materials on hull flexibility and on the concomitant bending and vibratory stresses for an ore carrier, a tanker, containership, and a general cargo ship is evaluated. With the flexibility of the ship's hull represented by the natural frequency of the ship associated with the two-node shape, a potentially useful relation between the flexibility and bending moment has been established.

AIRCRAFT

(Also see Nos. 1565, 1586, 1655, 1684, 1685, 1687, 1698, 1702, 1721, 1722, 1723, 1724, 1738, 1740)

80-1532
Transonic Wind Tunnel Tests on an Oscillating Wing with External Stores. Part III. The Wing with Tip Store
H. Tijdeman, J.W.G. van Nunen, A.N. Kraan, A.J. Persoon, and R. Poestkoke
National Aerospace Lab., Amsterdam, Netherlands, Rept. No. NLR-TR-78106-U-PT-3, AFFDL-TR-78-194-PT 3, 253 pp (May 1979)
AD-A074 910/1

Key Words: Aircraft wings, Wing stores, Wind tunnel tests

A wind-tunnel investigation was carried out on an oscillating model of the F-5 wing with and without an external store (AIM-9J missile). The store was mounted at the wing tip as well as at a pylon underneath the wing. Detailed steady and unsteady pressure distributions were measured over the wing, while on the store aerodynamic loads were obtained. In addition, wind-tunnel wall pressures were recorded. Emphasis is put on the influence of the store on the wing loading and further on the store loads. A comparison is presented of experimental data and theoretical results obtained with the unsteady NLRI and Doublet Lattice methods.

80-1533
Role of Shocks in the "Sub-Transonic" Flutter Phenomenon
H. Ashley
Stanford Univ., Stanford, CA, J. Aircraft, 17 (3), pp 187-197 (Mar 1980) 20 figs, 34 refs

Key Words: Flutter, Aircraft wings, Shock response

A semi-quantitative investigation is reported on the influence of partial-chord transonic shocks on flutter of "typical-section wing models. Unsteady airloads are assumed as the sum of linearized theory and a "shock-force doublet" centered at the measured steady shock location. The shock is shown usually to destabilize single-degree pitching motion; it may affect flexure-torsion flutter either way, often profoundly. Various typical-section parameters are studied, along with the important phase lag known to be present in the shock oscillation. Energy transfer during flutter is examined. Simplified calculations are presented that are believed relevant to the transonic tests by Farmer & Hanson.

80-1534
Harmonic Oscillations of Annular Wing in Steady Ideal Fluid Flow
Z.N. Shesternina
Allerton Press, Inc., New York, NY, In: Its Soviet Aeron., 21 (2), pp 93-98 (1978), Engl. transl. from Izv. Vyssh. Ucheb. Zaved. Aviats. Tekh., USSR, 21 (2), pp 115-121 (1978), For primary document, see

N80-11002, Avail: Allerton Press, Inc., 150 Fifth Ave., New York, NY 10011, $45.00

Key Words: Aircraft wings, Fluid-induced excitation, Harmonic response

A method is presented to solve the problem of the annular wing with thick profile, performing small harmonic oscillations in ideal incompressible fluid flow. Two cases are examined: axisymmetric flow with oscillations along the axis of symmetry; and flow with periodically varying small angle of attack.

80-1535

Evaluation of a Wind-Tunnel Gust Response Technique Including Correlations with Analytical and Flight Test Results

L.T. Redd, P.W. Hanson, and E.C. Wynne

NASA, Langley Res. Ctr., Hampton, VA, Rept. No. NASA-TP-1501, L-1313, 55 pp (Nov 1979)

N80-11028

Key Words: Testing techniques, Wind tunnel tests, Aircraft, Wind-induced excitation

A wind tunnel technique for obtaining gust frequency response functions for use in predicting the response of flexible aircraft to atmospheric turbulence is evaluated. The tunnel test results for a dynamically scaled cable supported aeroelastic model are compared with analytical and flight data. The wind tunnel technique, which employs oscillating vanes in the tunnel throat section to generate a sinusoidally varying flow field around the model, was evaluated by use of a 1/30 scale model of the B-52E airplane. Correlation between the wind tunnel results, flight test results, and analytical predictions for response in the short period and wing first elastic modes of motion are presented.

80-1536

Inclusion of Unsteady Aerodynamics in Longitudinal Parameter Estimation from Flight Data

M.J. Queijo, W.R. Wells, and D.A. Keskar

NASA, Langley Res. Ctr., Hampton, VA, Rept. No. NASA-TP-1536, L-13009, 52 pp (Dec 1979)

N80-12995

Key Words: Aircraft, Parameter identification technique, Aerodynamic characteristics, Mathematical models

A simple vortex system, used to model unsteady aerodynamic effects into the rigid body longitudinal equations of motion of an aircraft, is described.

80-1537

Dynamic Stall at High Frequency and Large Amplitude

L.E. Ericsson and J.P. Reding

Lockheed Missiles & Space Co., Inc., Sunnyvale, CA, J. Aircraft, 17 (3), pp 136-142 (Mar 1980) 11 figs, 33 refs

Key Words: Aircraft vibration, Aerodynamic loads

A previously developed quasisteady analytic method has been shown to give predictions that are in good agreement with experimental stall results as long as the oscillation amplitude and frequency are of moderate magnitudes. In the present paper, this quasisteady method is extended to include the transient effect of the "spilled" leading-edge vortex, thereby providing simple analytic means for prediction of dynamic stall characteristics at high frequency and large amplitudes. The veracity of the method is demonstrated by critical comparisons with the extensive experiments performed by Carr, et al.

80-1538

Aircraft Flutter and Dynamic Response

M. Geradin

Liege Univ., Belgium, In: Von Karman Inst. for Fluid Dyn. Aeroelastic Problems in Aircraft Design, 58 pp (1979)

N80-12010

Key Words: Aircraft, Flutter

The equations of motion and the dynamics of the elastic airplane are presented. The fundamentals of unsteady aerodynamics and an analysis of flutter and dynamic response are discussed.

80-1539

The Development of Active Control and its Application to Flutter Suppressors (Recents Progres sur les Controles Actifs Appliques aux Suppresseurs de Flottement)

R. Destuynder

Association Aeronautique et Astronautique de France, Paris, Rept. No. AAAF-NT-79-02, ISBN-2-7170-0529-3, 22 pp (1979)
N80-13056
(In French)

Key Words: Aircraft wings, Wing stores, Active control, Flutter, Wind tunnel tests

Wind tunnel tests were performed on an aeroelastic model of a fighter wing mounted on the tunnel wall with different types of stores such as a tank or wing tip stores, in order to investigate the possibility of controlling the flutter instabilities by means of the introduction of a control law acting upon wing stiffness. The results of two wind tunnel experiments in the high subsonic flow zone show that a relatively simple law can be used to suppress fluttering with the help of some experimental data. The difficulties introduced in the study of fully automatic control by the interaction between superimposed active control systems are pointed out.

80-1540

Ground Effects on Aircraft Noise

W.L. Willshire, Jr. and D.A. Hilton

NASA, Langley Res. Ctr., Hampton, VA, Rept. No. NASA-TM-80185, 71 pp (Nov 1979)
N80-12820

Key Words: Aircraft noise, Sound attenuation, Grass

A flight experiment was conducted to investigate air-to-ground propagation of sound near grazing incidence. A turbojet-powered aircraft was flown at low altitudes over the ends of two microphone arrays. Attenuation results obtained by using two methods were in general agreement.

80-1541

Near-Field Noise Prediction for Aircraft in Cruising Flight: Methods Manual (Final Report, May 1977 - June 1978)

T G Tibbetts

Lockheed-Georgia Co., Marietta, GA, Rept No. NASA-CR 159105, LG78ER0219, 97 pp (Aug 1979)
N80-12819

Key Words: Aircraft noise, Noise prediction

Methods for predicting noise at any point on an aircraft while the aircraft is in a cruise flight regime are presented. Developed for use in laminar flow control noise effects analyses, they can be used in any case where aircraft generated noise needs to be evaluated at a location on an aircraft while under high altitude, high speed conditions. Sample cases, for each of the individual noise source procedures, are provided to familiarize the user with typical input and computed data.

80-1542

General Aviation Noise Control - A Case Study

W.J. Critchfield

Torrance Municipal Airport, Torrance, CA, S/V, Sound Vib., 14 (2), pp 16-18 (Feb 1980)

Key Words: Aircraft noise, Noise reduction

The application of remedial measures to deal with noise from general aviation activity requires the commitment of resources and personnel to achieve long term benefits. Monitoring and analysis are necessary to establish and identify the scope and magnitude of the problem as well as identify individual trouble areas. Once the scope and magnitude are defined, remedial measures can be applied using land use controls, construction controls, pilot and community education, and, ultimately, enforcement of regulations.

80-1543

Advanced Turbo-Prop Airplane Interior Noise Reduction-Source Definition

B. Magliozzi and B.M. Brooks

Hamilton Standard, Windsor Locks, CT, Rept No. NASA-CR-159668, 90 pp (Oct 1979)
N80-13882

Key Words: Aircraft nosie, Noise reduction, Noise measurement, Wind tunnel tests

Acoustic pressure amplitudes and phases were measured in model scale on the surface of a rigid semicylinder mounted in an acoustically treated wind tunnel near a prop-fan (an advanced turbo-prop with many swept blades) model. Operating conditions during the test simulated those of a prop-fan at 0.8 Mach number cruise. Acoustic pressure amplitude and phase contours were defined on the semicylinder surface. Measurements obtained without the semi-cylinder in place were used to establish the magnitude of pressure doubling for an aircraft fuselage located near a prop-fan.

80-1544

A Study of the Prediction of Cruise Noise and Laminar Flow Control Noise Criteria for Subsonic Air Transports

G. Swift and P. Mungur

Lockheed-Georgia Co., Marietta, GA, Rept. No. NASA-CR-159104; 262 pp (Aug 1979)

N80-12818

Key Words: Aircraft noise, Noise prediction

General procedures for the prediction of component noise levels incident upon airframe surfaces during cruise are developed. Contributing noise sources are those associated with the propulsion system, the airframe and the laminar flow control system. Transformation procedures from the best prediction base of each noise source to the transonic cruise condition are established.

80-1545

Some Effects of Applying Sonic Boom Minimization to Supersonic Cruise Aircraft Design

R.J. Mack and C.M. Darden

NASA Langley Res. Ctr., Hampton, VA, J. Aircraft, 17 (3), pp 182-186 (Mar 1980) 13 figs, 16 refs

Key Words: Aircraft, Sonic boom, Wind tunnel tests, Design techniques

This paper presents a discussion of an aircraft shaping method to control sonic boom overpressure levels along with the analysis of wind tunnel data which validated the method. The results indicate that the sonic boom minimization method can guide the design team choices of aircraft planform and component arrangement toward a low-boom-level configuration while permitting sufficient freedom and flexibility to satisfy other design criteria. Further, it is shown that off-design flight conditions do not drastically change the overpressure sonic boom shape and strength.

80-1546

Overall Aerodynamic Characteristics of Caret and Delta Wings at Supersonic Speeds

Y.P. Gunko and I.I. Mazhul

Allerton Press, Inc., New York, NY, In: Its Soviet Aeron., 21 (2), pp 107-110 (1978), Engl. transl. from Izv. Vyssh. Ucheb. Zaved. Aviats. Tekh., USSR, 21 (2), pp 129-132 (1978). For primary document, see N80-11002. Avail: Allerton Press, Inc., 150 Fifth Ave., New York, NY 10011, $45.00

Key Words: Aircraft, Supersonic aircraft, Aircraft wings, Aerodynamic characteristics

The influence of caret angle, design Mach number, and free stream Mach number on the aerodynamic characteristics of caret wings are studied experimentally and theoretically. Caret wings and their equivalent delta wings are compared in the class with constant volume coefficient and aspect ratio. The results obtained relate basically to the flow regimes around caret wings with free stream Mach number less than design Mach number.

80-1547

Wind-Tunnel/Flight Correlation Study of Aerodynamic Characteristics of a Large Flexible Supersonic Cruise Airplane Cxb-70-1). 1: Wind-Tunnel Tests of a 0.03-Scale Model at Mach Numbers from 0.6 to 2.53

J. Daugherty

NASA, Ames Res. Ctr., Moffett Field, CA, Rept. No. NASA-TP-1514, A-7712, 222 pp (Nov 1979)

N80-11068

Key Words: Aircraft, Supersonic aircraft, Wind tunnel tests, Aerodynamic characteristics

The longitudinal and lateral forces and moments for a 0.03 scale deformed rigid, static force model of the XB-70-1 airplane were determined. Control effectiveness was determined for the elevon in pitch and roll, for the canard, and for the rudders. Component effects of the canard, deflected with tips, variable position canopy, bypass doors, and bleed dump fairing were measured. The effects of small variations in inlet mass flow ratio and small amounts of asymmetric deflection of the wing tips were assessed.

80-1548

New Remotely Piloted Vehicle Launch and Recovery Concepts - Computer Program Listings

S.J. Baumgartner, R.F. Yurczyk, J.G. Brister, and V.K. Rajpaul

Boeing Aerospace Co., Seattle, WA, Rept. No. AF-FDL-TR-79-3069-VOL-2, 173 pp (June 1979)

AD-A076 611/3

Key Words: Computer programs, Air bags (soft landing), Air cushion landing systems, Landing gear, Aircraft

Dynamic analysis, preliminary design, and performance/cost trade studies of air bag skid and air cushion concepts

for launch and recovery of Boeing and Rockwell advanced RPV concepts are reported.

80-1549

Comparative Analysis of PA-31-350 Chieftain (N44-1v) Accident and NASA Crash Test Data

R.J. Hayduk

NASA, Langley Res. Ctr., Hampton, VA, Rept. No. NASA-TM-80102, L-13064, 59 pp (Oct 1979)

N79-33172

Key Words: Crash research (aircraft), Simulation, Experimental data

A full scale, controlled crash test to simulate the crash of a Piper PA-31-350 Chieftain airplane is described. Comparisons were performed between the simulated crash and the actual crash in order to assess seat and floor behavior, and to estimate the acceleration levels experienced in the craft at the time of impact. Measured impact parameters are presented along with flight path velocity and angle in relation to the impact surface.

80-1550

Light Airplane Crash Tests at Three Pitch Angles

V.L. Vaughan, Jr. and E. Alfaro-bou

NASA, Langley Res. Ctr., Hampton, VA, Rept. No. NASA-TP-1481, 62 pp (Nov 1979)

N80-11505

Key Words: Aircraft, Crash research (aircraft), Test facilities

Three similar twin-engine general aviation airplane specimens were crash tested at an impact dynamics research facility. The test facility, instrumentation, test specimens, and test method are briefly described. Structural damage and accelerometer data for each of the three impact conditions are presented and discussed.

80-1551

Light Airplane Crash Tests at Three Roll Angles

C.B. Castle and E. Alfaro-bou

NASA, Langley Res. Ctr., Hampton, VA, Rept. No. NASA-TP-1477, L-12778, 77 pp (Oct 1979)

N80-10512

Key Words: Crash research (aircraft), Experimental data

Three similar twin engine general aviation airplanes were crash tested at the Langley impact dynamics research facility. The test facility, instrumentation, test specimens, and test method are briefly described. Structural damage and accelerometer data for each of the three impact conditions are presented and discussed.

80-1552

Noise of a Model Helicopter Rotor Due to Ingestion of Turbulence

R.W. Paterson and R.K. Amiet

United Technologies Res. Ctr., East Hartford, Ct, Rept. No. NASA-CR-3213, 131 pp (Nov 1979)

N80-11067

Key Words: Helicopter rotors, Noise generation

A theoretical and experimental investigation of the noise of a model helicopter rotor due to ingestion of turbulence was conducted. Results indicate that ingestion of atmospheric turbulence is the dominant helicopter rotor hover noise mechanism at the moderate to high frequencies which determine perceived noise level.

80-1553

An Analytical Investigation of the Effect of Varying Rotor Tip Speed to Reduce Helicopter Acoustic Detection

B.W. Scruggs, Jr. and K.D. Hampton

Army Res. and Tech. Labs., Fort Eustis, VA, Rept. No. USARTL-TN-37, 34 pp (Aug 1979)

AD-A076 961/2

Key Words: Helicopter rotors, Noise reduction

The purpose of this study was to analytically determine the effect of incrementally varying helicopter rotor tip speed to decrease noise levels and detection distance. It was also found that overall sound pressure levels was not a reliable indicator of detectability and that ambient noise conditions had the largest net effect on detectability.

80-1554

Coupled Rotor and Fuselage Equations of Motion

W. Warmbrodt

NASA, Ames Res. Ctr., Moffett Field, CA, Rept. No. NASA-TM-81153, 82 pp (Oct 1979)

N80-10516

Key Words: Helicopters, Helicopter rotors, Rotor-induced vibration, Equations of motion

The governing equations of motion of a helicopter rotor coupled to a rigid body fuselage are derived. A consistent formulation is used to derive nonlinear periodic coefficient equations of motion which are used to study coupled rotor/fuselage dynamics in forward flight. Rotor/fuselage coupling is documented and the importance of an ordering scheme in deriving nonlinear equations of motion is reviewed. The nature of the final equations and the use of multiblade coordinates are discussed.

MISSILES AND SPACECRAFT

(Also see No. 1714)

80-1555

Investigation of High Frequency Oscillations in the OV102 Elevon Actuation Subsystems Using Continuous System Modeling Program Simulation

W.W. Powell, Sr

Systems and Services Div., Lockheed Electronics Co., Houston, TX, Rept. No. NASA-CR-160407, JSC-14765, 70 pp (July 1979)

N80-13151

Key Words: Spacecraft, High frequency response, Simulation

Two theories emerged as the cause of undesired oscillations at frequencies between 40 and 60 Hz in the Orbiter Vehicle inboard and outboard elevon actuation subsystems during hardware testing. Both the 'hardover feedback' and 'deadspace' theories were examined using continuous system modeling program simulation. Results did not support the 'hardover feedback' theory but showed that deadspace in the torque feedback spring connections to the servospools must be considered to be a possible cause of the oscillations.

BIOLOGICAL SYSTEMS

ANIMAL

(See No. 1519)

MECHANICAL COMPONENTS

ABSORBERS AND ISOLATORS

(Also see Nos. 1539, 1543, 1595, 1707)

80-1556

Energy Absorption by Foam Filled Structures

P.H. Thornton

Ford Motor Co., Dearborn, MI, SAE Paper No. 800081, 16 pp, 14 figs, 1 table, 19 refs

Key Words: Energy absorption, Foams

The energy absorbed during the axial collapse of a variety of structures made of steel, aluminum alloy and glass fiber reinforced plastics is examined with respect to the changes produced by foam filling. A simple model is devised which permits reasonable estimates of the axial collapse load for a structure and an assessment of the weight effectiveness of foam filling for that structure. Design charts are given, from which the dimensions can be derived for sections made in either steel or aluminum alloys of any particular strength level, in order to establish the weight effectiveness of foam filling.

80-1557

The Effect of Spring Nonlinearities in a Self-Excited System with a Tuned Absorber

A. Tondl

Nat. Res. Institute for Machine Design, 250 97 Praha 9 - Bechovice, Czechoslovakia, Intl. Conf. on Nonlinear Oscillations, Proc. of the 8th Institute of Thermomechanics, Czech. Acad. Sci., Prague, 1978, pp 701-706, 3 figs, 6 refs

Key Words: Absorbers (equipment), Tuned dampers, Nonlinear springs

A two-mass system consisting of a basic self-excited subsystem of Van der Pol oscillator and of a tuned absorber subsystem is investigated. Under defined conditions for the system parameters, there exists a certain interval of the tuning coefficient values (optimum tuning) for which the equilibrium position is stable. It is shown that the spring nonlinearities can change the system in such a way that an oscillatory stationary solution can also exist in the interval mentioned.

80-1558

Energy Absorption by the Structural Collapse of Spot-Welded Sheet Metal Sections

P.H. Thornton

Ford Motor Co., Dearborn, MI, SAE Paper No. 800372, 16 pp, 16 figs, 1 table, 17 refs

Key Words: Absorbers (materials), Energy absorption, Dynamic buckling, Metals

The crush characteristics of various spot-welded sections were assessed on the basis of material property and geometry contributions, according to three structural collapse models. It was found that the predicted mean crush loads differed significantly from the measured values in many cases, particularly for the heavier wall sections, when models based upon *effective plate width concepts were used.*

80-1559

Energy Absorption of Plastic, Steel, and Aluminum Shells Under Impact Conditions

R.C. Van Kuren

Forming and Mechanical Evaluation Section, Res. Dept., Bethlehem Steel Corp., SAE Paper No. 800371, 16 pp, 13 figs, 3 tables, 22 refs

Key Words: Absorbers (materials), Energy absorption, Dynamic tests, Aluminum, Reinforced plastics, Plastics, Steel, Experimental data

The energy absorption of several automotive materials, i.e., reinforced plastics, steel, and aluminum, was determined at 70 and -40 F (21 and -40 C) by crushing curved shell specimens at impact speeds up to 25 mph (40 km/h). This specimen, which resembles a small body part, permitted comparing the energy absorption characteristics of widely diverse engineering materials under identical simulative highway conditions.

80-1560

Development of a Preloaded, Force-Limited Passive Belt System for Small Cars

M.J. Walsh and B.J. Kelleher

Calspan Corp., Advanced Tech. Ctr., Buffalo, NY, SAE Paper No. 800300, 20 pp, 21 figs, 3 tables, 12 refs

Key Words: Collision research (automotive), Automobiles, Automobile seat belts, Safety restraint systems, Experimental data, Computerized simulation

A preloaded, force-limited passive belt restraint system for small cars was developed and evaluated through computer *simulation and sled tests. This paper presents and discusses* the results of the developmental program at velocity changes of 35, 40 and 45 MPH during symmetric frontal barrier crash sled and computer simulations with regard to the effect upon 50th, 95th, 5th percentile and 6 year old sized anthropometric test devices (ATDs).

80-1561

Small-Car Airbag Restraints Developed

D.J. Romeo and D.T. Zinke

Tally Industries of Arizona, Auto. Engr. (SAE), 88 (2), pp 33-39 (Feb 1980)

Key Words: Safety restraint systems, Air bags (safety restraint systems)

An evaluation of airbag restraint systems for front-seat occupants of small automobiles is presented.

80-1562

The Development of Air Cushion Restraint Systems for Small Car Front Seat Occupants

D.T. Zinke

Minicars, Inc., SAE Paper No. 800294, 12 pp, 11 figs, 7 tables

Key Words: Air bag safety restraint, Safety restraint systems, Automobiles

This paper presents progress on the development and evaluation of three front seat airbag restraint systems for small cars. *The subject vehicles were a Chevrolet Chevette,* for which a passenger restraint system was developed, and a Dodge Omni, for which both driver and passenger systems were developed. The systems were primarily evolved during a series of sled tests and evaluated in vehicle barrier impacts.

80-1563

Driver and Passenger Air Bag Unit Assemblies

D.J. Romeo

Talley Industries of Arizona, Inc., Mesa, AZ, SAE Paper No. 800293, 8 pp, 5 figs, 18 refs

Key Words: Safety restraint systems, Air bags (safety restraint systems), Collision research (automotive)

The air bag restraint system or automatic restraint system is specifically designed to control forces and deceleration to the human body during an automobile accident.The three basic components comprising the air bag restraint system include: the crash sensor (s), the diagnostic package for determining operability status, and the driver and front passenger air bag assemblies. The information presented is limited to a description and the operational features of the driver and passenger unit assemblies; parts which are located in the steering wheel and instrument panel respectively. Both assemblies consist of three basic components: the inflator, the module, and the air bag.

80-1564

Dynamic Analysis to Establish Normal Shock and Vibration of Radioactive Material Shipping Packages

S.R. Fields and S.J. Mech

Hanford Engineering Development Lab., Richland, WA, Rept. No. HEDL-TME-79/43, 44 pp (Oct 1979) NUREG/CR-1066

Key Words: Shipping containers, Radioactive materials, Transportation effects

The purpose of this study was to identify those parameters which significantly affect the normal shock and vibration environments experienced by radioactive material shipping packages during normal transport conditions. Determination of these forces will provide the input data necessary for a broad range of package-tiedown structural assessments.

80-1565

Active Flutter Control for Flexible Vehicles, Volume I

J.K. Mahesh, W.L. Garrard, C.R. Stones, and P.C. Hausman

Honeywell, Inc., Minneapolis, MN, Rept. No. NASA-CR-159160, 78 pp (Nov 1979)
N80-13053

Key Words: Flutter, Active control, Aircraft, Computer programs, Mathematical models

An active flutter control methodology based on linear quadratic gaussian theory and its application to the control of a super critical wing is presented. Results of control surface and sensor position optimization are discussed. Both frequency response matching and residualization used to obtain practical flutter controllers are examined. The development of algorithms and computer programs for flutter modeling and active control design procedures is reported.

80-1566

Subcompact Vehicle Energy Absorbing Steering Column Evaluation and Improvement. Volume III: Appendices

K. Humann and A.V. Khadilkar

Minicars, Inc., Goleta, CA, Rept. No. IR-1061-06-79(3), DOT-HS-805 076, 106 pp (June 1979)
PB80-114267

Key Words: Energy absorption, Steering gear, Automobiles, Collision research (automotive)

This volume of the project interim report presents the appendices of corresponding Volume I and II. The appendices contain the following information: Appendix A - Coding and distribution of significant variables; Appendix B - Sample collision performance and injury report (CPIR) used for MDAI data; Appendix C - Sample accident investigation report, University of Birmingham; Appendix D-MDAI codebook; Appendix E - Birmingham data codebook; Appendix F - Listing of accident cases and important variables for the MDAI 108, MDAI 78 and Birmingham 53 data files; Appendix G - Example of a CRASH2 computer simulation; Appendix H - Frequency distributions and classifications for important MDAI and Birmingham variables; Appendix I - 'Measurement of Thoracic Injury in Collision Simulations Using Anthropomorphic Dummies.'

80-1567

Subcompact Vehicle Energy Absorbing Steering Column Evaluation and Improvement. Volume I: Analysis of Accident Data Engineer's Point of View

A.V. Khadilkar, K. Humann, T.R. Egberg, and L. Phillips

Minicars, Inc., Goleta, CA, Rept. No. IR-1061-06-79(1), DOT-HS-805 074, 100 pp (June 1979)
PB80-114242

Key Words: Energy absorption, Steering gear, Automobiles, Collision research (automotive), Statistical analysis

The report describes the statistical analysis of automobile accident cases for the purpose of determining the injury causing factors involved in subcompact vehicle driver-steering assembly interaction during impact. The statistical analysis techniques discussed are 'Principal Component Analysis,' 'Contingency Table Analysis,' and 'Discriminant Function Analysis.' These techniques were applied to data sets consisting of 108 Multi-disciplinary Accident Investigation team cases and 53 cases recorded by the University of Birmingham, England, Accident Research Unit. The accidents analyzed consisted of frontal impacts of unrestrained drivers. The analysis developed a methodology for the determination and illustration of the injury causing and injury indicating factors in automobile accidents. This is Volume I of the project interim report and describes the analysis from the engineer's point of view.

80-1568

Dual-Mode Suspension Carries Speedy Bulldozer

Des. News, pp 84-85 (Oct 22, 1979) 4 figs

Key Words: Suspension systems (vehicles), Earth handling equipment

One of the key features of the army's newest multipurpose earth-moving machine (designated the M-9) is a hydropneumatic suspension system that allows vehicle operation in both the sprung and unsprung modes. For functions such as dozing, scraping and rough grading, the suspension is operated rigid, or unsprung, by locking out the pneumatic springs (accumulators) and controlling the position of the cutting edges through individual suspension units. Transport functions are performed in the sprung mode by direct connection of the suspension units to the accumulators, resulting in smooth ride characteristics at speeds to 30 mph.

80-1569

An Optimal Linear Active Suspension with Finite Road Preview

A.G. Thompson, B.R. Davis, and C.E.M. Pearce

Univ. of Adelaide, Adelaide, South Australia, SAE Paper No. 800520, 16 pp, 5 figs, 2 tables

Key Words: Suspension systems (vehicles), Active control, Electrohydraulic systems, Random excitation

A theory of optimal feed-forward control is developed, for a linear system with a disturbance input, based on the analogy between a filtered white noise and a unit step. The theory is applied to an active unicycle suspension on a random road with finite preview and the effect of preview time on the performance index determined. The electrohydraulic system proposed has a fixed preview distance and requires feedback of the body state variables plus feedforward of the previewed road input through a shift register sequence which is adaptable to a wide range of speeds by automatic switching.

80-1570

Design and Validation of Variable Rate Pneumatic Springs

T.E. Burkley and P.F. Myers

Goodyear Tire & Rubber Co., SAE Paper No. 800-483, 8 pp, 3 figs

Key Words: Pneumatic springs, Suspension systems (vehicles)

This paper provides information on theory and design methods used to tailor pneumatic spring rate and natural frequency. Equations utilized in the design procedure are presented, and the interaction of the important variables is discussed. The vital role of laboratory testing and validation is emphasized. Although the paper is restricted to pneumatic spring design, peripheral equipment such as leveling valves and auxiliary reservoirs are addressed.

80-1571

Ball Joint Front Suspension and Its Application to the New 1952 Lincoln Automobile

E.S. MacPherson and P.H. Pretz

Ford Motor Co., SAE Paper No. 800518, 12 pp, 15 figs

Key Words: Suspension systems (vehicles), Ball joints, Joints (junctions)

Substantial progress in the art of suspension design was made when the ball joint front suspension system was incorporated in the 1952 Lincoln. More usable space was provided, suspension serviceability was made much easier, and exceptional flexibility for future design changes resulted from the use of this suspension system.

SPRINGS

(See Nos. 1557, 1570, 1689)

TIRES AND WHEELS

(See Nos. 1668, 1669, 1670, 1690, 1691, 1692)

BLADES

80-1572

Fatigue Life Estimates of Mistuned Blades Via a Stochastic Approach

G. Sogliero and A.V. Srinivasan

Trinity College, Hartford, CT, AIAA J., 18 (3), pp 318-323 (Mar 1980) 5 figs, 9 refs

Key Words: Blades, Rotor blades, Fatigue life, Stochastic processes, Statistical analysis

This paper examines the vibratory characteristics of bladed disk assemblies with random distribution of frequencies of individual blades around the rotor. A statistical procedure is developed and applied to obtain an estimate of expected time of failure of an assembly of 24 blades under excitation by a stationary Gaussian white noise process. The stimate is based on four blade populations consisting of 240 randomly generated frequencies -- each population having the same mean but a different standard deviation. This limited study has shown that the standard deviation of the blade frequency is an important parameter that affects the average life of vibrating blades.

80-1573

Blade Bending Vibration Induced by Wakes

T. Matsuura

Toshiba Turbine Works, Yokohama, Japan, J. Mech. Engr. Sci., 21 (5), pp 361-362 (Oct 1979) 2 figs, 3 refs

Key Words: Blades, Compressor blades, Flexural vibration

The amplitude of vibration of the blades of a compressor rotor due to upstream periodic wakes is investigated. Good agreement is found between the calculated results, using the unsteady force coefficients given by Smith and those obtained by experiment.

80-1574

Model 540 Rotor Blade Crack Propagation Investigation

D.E. Good

Army Res. and Technology Labs., Fort Eustis, VA, Rept. No. USARTL-TR-79-26, 35 pp (Aug 1979) AD-A074 734/5

Key Words: Blades, Rotor blades, Crack propagation, Fatigue tests

The rate of crack propagation from an induced defect in a metal Bell Helicopter 540 main rotor blade was investigated. A controlled crack front was introduced into the top surface of the blade spar. Fatigue testing was conducted at maximum level flight loads and the crack growth was monitored. Experimental data was then compared with analytical predictions to measure the ability to predict crack growth characteristics.

BEARINGS

(Also see Nos. 1480, 1481)

80-1575

Steady-State and Dynamic Behaviour of Multi-Recess Hybrid Oil Journal Bearings

M.K. Ghosh, B.C. Majumdar, and J.S. Rao

B.H.U., Varanasi, India, J. Mech. Engr. Sci., 21 (5), pp 345-351 (Oct 1979) 8 figs, 1 table, 12 refs

Key Words: Bearings, Journal bearings, Periodic response, Perturbation theory

A theoretical analysis of the steady-state and dynamic characteristics of multi-recess hybrid oil journal bearings is presented. A perturbation theory for small vibrations is used to solve an incompressible, finite journal bearing with a time-dependent term. Load capacity, attitude angle, friction parameter, stiffness and damping coefficients are evaluated for a capillary-compensated bearing.

80-1576

Nonlinear Pad Functions for Static Analysis of Tilting Pad Bearings

F.E. Andritsos and A.D. Dimarogonas

Univ. of Patras, Patras, Greece, J. Lubric. Tech., Trans. ASME, 102 (1), pp 25-33 (Jan 1980) 11 figs, 5 tables, 11 refs

Key Words: Bearings, Tilting pad bearings, Numerical analysis, Nonlinear response, Dynamic response

Nonlinear damping pad functions are used for investigating the dynamic behavior of tilting pad bearings. This procedure can be used in two ways: to tabulate the functions for an adequate constellation of the design parameters of the pads and from them compute the performance parameters of the bearing such as load carrying capacity and linear coefficients; and to incorporate these functions into a nonlinear numerical analysis of the dynamic response of the rotor-bearing system. Comparison of the static state results with previous investigations on complete bearings shows a good agreement while existing numerical solutions give unacceptable results for wide areas of bearings operation.

GEARS

80-1577

Dynamic Behavior of Straight Bevel Gear (1st Report, Dynamic Load, Torque Variation and Bending Vibration of Gear Shaft)

Y. Terauchi, Y. Miyao, M. Fujii, and K. Sagawa

Faculty of Engrg., Hiroshima Univ., Sendamachi 3 chome, Hiroshima, Japan, Bull. JSME, 23 (175), pp 126-131 (Jan 1980) 17 figs, 1 table, 1 ref

Key Words: Gears, Dynamic structural analysis

Using a power circulating type gear testing machine for straight bevel gears, the dynamic load of gear teeth, the torque variation and the bending vibration of gear shaft are measured under a constant torque with varied gear speed. It was found that as the speed of gear increases, the dynamic load factor varies in accordance with the contact position on a tooth trace and the load.

80-1578

Dynamical Distinctive Phenomena in Gear System

K. Sato, O. Kamada, and N. Takatsu

Utsunomiya Univ., 2753, Ishiicho, Utsunomiya, 321-31 Japan, Bull. JSME, 22 (174), pp 1840-1847 (Dec 1979) 22 figs, 7 refs

Key Words: Gears, Harmonic balance method, Transformation techniques

The relation between jump phenomena or subharmonic oscillation and the gear system parameters, as well as the geometrical behavior of the phenomena on the phase plane, are investigated. The method of harmonic balance and the transformation theory is used.

80-1579

Investigation on Dynamic Oil-film-formation and Pitting in Spur Gear (2nd Report, Quantitative Evaluation of the State of Local Oil-film-formation)

K. Ichimaru, F. Hirano, K. Kinoshita, and M. Nishimura

Faculty of Engrg., Kyushu Univ., Fukuoka, Japan, Bull. JSME, 23 (175), pp 97-102 (Jan 1980) 8 figs, 3 refs

Key Words: Gears, Spur gears, Oil film, Dynamic response, Statistical analysis

In a quantitative evaluation of the local state of oil-film-formation in spur gears, the voltage between meshing teeth, measured by electrical resistance method, was analyzed statistically using an analog-digital converter and an electronic computer. The local state of oil-film-formation at every meshing position on the line of action, or on a pair of gears was evaluated as the distribution of the voltages between meshing teeth. It is shown that the local state of oil-film-formation in gears is affected significantly by the dynamic load and the surface defect of gear teeth. These analyses will be useful for elucidation of the mechanism of pitting in gears.

80-1580

Planet Indexing in Planetary Gears for Minimum Vibration

A. Toda and M. Botman

Pratt & Whitney Aircraft of Canada Ltd., Longueuil, Quebec, Canada, ASME No. 79-DET-73, 10 figs, 1 table, 7 refs

Key Words: Gear boxes, Gears, Geometric imperfection effects, Vibration measurement

The vibration level measured on the casing of the reduction gearbox of the PT6 turboprop engine is a good indicator of the quality of the gears and the gear assembly. The gears of these planetary gear stages are subject to machining errors. In the planets the spacing error, which affects the relative spacing of the teeth, is an important contributor to the vibra-

tion. Tests have shown that the effect of the spacing errors and the resulting vibration can be minimized by proper indexing of the planets with respect to each other.

FASTENERS

80-1581

The Effects of Plating on Torque/Tension Relationship and Vibration Resistance

J. McKewan

Everlock, a Microdot Co., SAE Paper No. 800452, 8 pp, 12 figs

Key Words: Fasteners, Vibration response

Alternatives to cadmium plating on fasteners are investigated from the point of view of cost, corrosion resistance, torque/tension relationships and vibration resistance. Conclusions show that these are interrelated and point to the direction to be taken dependent on the criteria of the fastened joint under consideration.

LINKAGES

(Also see No. 1571)

80-1582

The Control of Structural Vibration by Frictional Damping in Electro-Discharge Machined Joints

C.F. Beards and A.A. Neroutsopoulos

Dept. of Mech. Engrg., Imperial College of Science and Tech., London, UK, J. Mech. Des., Trans. ASME, 102 (1), pp 54-57 (Jan 1980) 5 figs, 12 refs

Key Words: Joints (junctions), Dynamic stiffness, Internal damping

EDM joints are attractive for use in structures because the machining operation is cheap and easy to perform, while producing joints with good conformity of interface. It is shown that EDM joints have high static and dynamic stiffness and possess up to 100 percent more damping capacity than ground joints, while surface damage due to fretting corrosion is reduced by an order of magnitude. For all joints tested, the fretting action caused an increase in the damping and a decrease in the dynamic stiffness, the maximum variations being 60 percent and 5 percent respectively, after 10^7 cycles.

80-1583

The Influence of Joint Dimensions on the Fatigue Strength of Welded Tubular Joints

J.G. Wylde and A. McDonald

Intl. J. Fatigue, 2 (1), pp 31-36 (Jan 1980) 9 figs, 11 refs

Key Words: Joints (junctions), Fatigue tests, Experimental data

The preliminary results of static and fatigue tests on welded tubular joints are described. The specimens tested were tubular T-joints ranging in diameter from 168 mm to 1830 mm and in wall thickness from 6 mm to 76 mm. The specimens were tested under axial loading and under in-plane and out-of-plane bending moments. The results are compared with those obtained by other investigators and it is shown that the fatigue strength decreases with increase in joint dimensions. This conclusion is discussed in the context of the current Q-curve proposed for use as a design curve for tubular joints.

80-1584

Fatigue Crack Growth in Tubular Welded Connections

W.D. Dover and S.J. Holdbrook

Intl. J. Fatigue, 2 (1), pp 37-42 (Jan 1980) 18 figs, 2 tables, 10 refs

Key Words: Joints (junctions), Fatigue tests, Crack propagation, Finite element technique

A series of tests have been conducted on tubular welded T-joints using out-of-plane bending. The complete test series is designed to measure the stress distribution and the fatigue strength, for this size of T-joint, under random loading. The work presented here includes the experimental strain analysis, together with Finite Element results, and fatigue crack growth measurements. These results show that it will be possible to estimate the fatigue life of T-joints using a fracture mechanics approach.

VALVES

(Also see No. 1661)

80-1585

Failure of Safety Valves Due to Flow-Induced Vibration

J.T. Coffman and M.D. Bernstein

Oklahoma Gas and Electric Co., Oklahoma City, OK 73101, J. Pressure Vessel Tech., Trans. ASME, 102 (1), pp 112-118 (Feb 1980) 4 figs, 10 refs

Key Words: Valves, Fluid-induced excitation, Cavity resonators, Acoustic excitation, Failure analysis

Flow-induced sonic vibration in boiler safety valve nozzles, which leads to premature valve wear and failure, was stopped by replacing the cylindrical valve nozzles with reducers. A review of flow-induced cavity vibrations is presented. In the case of the safety valves the vibration is believed due to fluid-dynamic instability of the cavity shear layer, enhanced and controlled by the resonant characteristics of the adjacent cavity. The precise feedback, or coupling, mechanism that sustains the oscillation is unknown. Possible reasons for the success of the tapered shape reducer are discussed. The limited design guidance available for safety valve placement is reviewed. Results of a safety valve vibration experience survey are presented and discussed. A two-parameter guideline for safety valve placement is suggested, involving steam velocity in addition to valve location. Possible future work on safety vibration is outlined.

80-1586

Crashworthy Fuel System

D.T. Redman

Dept. of the Army, Washington, D.C., PAT-APPL-6-028 040, 11 pp (Apr 9, 1979)

Key Words: Aircraft, Crash research (aircraft), Fuel tanks, Valves, Crashworthiness

A crashworthy fuel system for aircraft or the like comprising a fuel tank and a valve for securement to the bottom of the tank. The valve comprises a generally L-shaped body having a first leg and a second leg extending generally at right angles to the first leg. A main flow passage extends through the entire length of the body. The first leg has a peripheral flange spaced from its outer end which is secured in face-to-face relation to the bottom of the tank with the outer end of the first leg extending up through a hole in the bottom of the tank into the interior of the tank for flow of fuel into the main flow passage and the second leg extending below the tank on the outside thereof for connection at its outer end to a fuel delivery line. The second leg has a circumferential area of weakness adjacent to the flange between the flange and the first leg. A valve is provided in the main flow passage between this area of weakness and the inlet end of the main flow passage for sealing the main flow passage in the event of rupture of the valve body at the area of weakness, as during a crash of the aircraft. A valve is also provided toward the outlet end of the main flow passage for draining the latter.

SEALS

80-1587

The Effect of Flexible Mounting of Seals on the Onset Limit of Self-Excited Vibration

A. Tondl

SVUSS, 250 97 Praha 9 - Bechovice, CSSR, Dynamika Strojov, Slovenska Akademia vied Ustav mechaniky strojov. zbornik referatov XII konferencie, pp 775-786 (Apr 1979) 6 figs, 1 ref

Key Words: Seals (stoppers), Rotating structures, Critical speeds, Pumps

The effectiveness of raising the onset speeds of instability of rotating machinery by flexible mounting of seals is investigated. This problem is particularly serious in radial centrifugal pumps. The overpressure at one side of the seal produces axial flow which in turn generates, in the seal slot, a central force field having a certain stiffness. Hydrodynamic (aerodynamic) forces induced by the rotating shaft have the same character as those in journal bearings. A simple model of a rotor system and of acting forces is considered.

STRUCTURAL COMPONENTS

STRINGS AND ROPES

80-1588

Lateral Motion of an Axially Moving String on a Cylindrical Guide Surface

K. Ono

Musashino Electrical Communication Lab., Nippon Telegraph and Telephone Public Corp., Tokyo, Japan, J. Appl. Mech., Trans. ASME, 46 (4), pp 905-912 (Dec 1979) 12 figs

Key Words: Moving strips, Strings

Lateral motion of an axially moving string on a cylindrical guide surface is investigated theoretically and experimentally. By deriving and solving the basic equation of the system, it is found that the axially moving string slips laterally on the fixed guide surface similarly to one-dimensional heat flow. The transfer characteristics of the string lateral displacement

from one side to the other over the guide surface depends on the string transport direction, if the circumferential and axial friction coefficients between string and guide are different from each other. The solution for a rotary guide can be obtained as the limiting case where the circumferential friction coefficient is zero and the axial friction coefficient is infinity.

80-1589

V-Belt Reliability -- A Statistical Study of Large Sample Size Fatigue Tests

J.D. Shepherd and L.L. Jackson

Gates Rubber Co., SAE Paper No. 800446, 12 pp, 10 figs, 5 refs

Key Words: V-belts, Power transmission belts, Fatigue tests, Statistical analysis

This statistical study of V-belt fatigue testing, with sample sizes of over 5,000, yields a valuable insight into V-belt reliability. With this basic information, the design engineer can have a firm base for establishing a relationship between laboratory and field testing, and drive design calculations. The data can then be related to projected reliability on the actual application. It will also serve as a reference base for establishing practical quality control standards.

BEAMS

(Also see No. 1700)

80-1590

Vibration of a Cantilever Beam that Slides Axially in a Rigid Frictionless Hole

A.P. Boresi and D. Salinas

Naval Postgraduate School, Monterey, CA, Rept. No. NPS-69-79-009, 24 pp (Sept 1979)

AD-A075 944/9

Key Words: Beams, Cantilever beams, Vibration response, Finite element technique

This paper considers a cantilever beam which can move in and out of a rigid frictionless hole. Hamilton's principle is used for the development of two governing equations, and boundary conditions defined over a moving boundary. A transformation of coordinates is used to transform the problem into a system of two nonlinear p.d.e. defined over a fixed region. A discussion of some mathematical and physical considerations is presented. Finally, a finite element formulation of the problem is presented.

80-1591

Transverse Vibrations of Linearly Tapered Beams with Ends Restrained Elastically Against Rotation Subjected to Axial Force

K. Sato

Dept. of Mech. Engrg., Tohoku Univ., Sendai, Japan, Intl. J. Mech. Sci., 22 (2), pp 109-115 (1980) 7 figs, 2 tables, 5 refs

Key Words: Beams, Variable cross section, Flexural vibration, Fundamental frequency, Ritz method

It is the object of this investigation to examine the effect of an axial force on the frequencies of linearly tapered beams with ends restrained elastically against rotation. The buckling of the system is also discussed. The fundamental eigenfrequencies of the beams with two types of linear tapers are obtained numerically by means of the Ritz method. Numerical results for various taper ratios are shown in graphs and tables against the axial forces and the degrees of end fixity.

80-1592

Response of Constrained Visco-Elastic Beams to Random Excitation

O.N. Kaul, K.N. Gupta, and B.C. Nakra

Indian Inst. of Tech., New Delhi, India, Arch. Mech., 31 (6), pp 875-896 (1979) 19 figs, 22 refs

Key Words: Beams, Random excitation, Flexural vibration, Viscoelastic core-containing media, Sandwich structures

The paper deals with analytical formulations for flexural vibrations of simply supported three-layer beams which have a constrained viscoelastic core and are subjected to random excitation of white noise and turbulent boundary layer types, respectively. By applying the usual analytical techniques of random vibration, the expressions for the mean square displacement response of the beam are obtained in terms of its transfer function and the spectral density of the input process. Experiments have been conducted on a few samples of the sandwich beam for both types of excitation and the test results are being compared with the corresponding theoretical results. A reasonable agreement between these results has been observed.

80-1593

The Steady State In-Plane Response of a Curved Timoshenko Beam with Internal Damping

T. Irie, G. Yamada, and I. Takahashi

Dept. of Mech. Engrg., Hokkaido Univ., North-13, West-8, Sapporo 060, Japan, Ing. Arch., 49 (1), pp 41-49 (1980) 6 figs, 1 table, 10 refs

Key Words: Beams, Curved beams, Timoshenko theory, Internal damping, Periodic response, Transfer matrix method

The steady state in-plane response of a curved Timoshenko beam with internal damping to a sinusoidally varying point force or moment is determined by use of the transfer matrix approach. The method is applied to free-clamped non-uniform beams with circular, elliptical, catenary or parabolical neutral axis excited at the free end; the driving point impedance and force or moment transmissibility are calculated numerically and the influence of the varying cross-section and of the function expressing the neutral axis are studied.

80-1594

Transient Response of Beams to Correlated Random Excitation Applied at the Boundaries

A. Aryafar, S.F. Masri, and F.E. Udwadia

Dept. of Civil Engrg., Univ. of Southern California, Los Angeles, CA, Rept. No. NUREG/CR-1068, 168 pp (Dec 1979)

Key Words: Beams, Transient response, Random excitation, Viscous damping

An investigation is made of the transient mean-square response of viscously damped Bernoulli-Euler and shear beams subjected to a correlated random excitation, applied at the boundaries. Closed-form solutions are presented for both types of beams, and an appropriate autocorrelation function is used to evaluate the response. The beam is subjected to a propagating stationary random excitation at the supports. The response of arbitrary points along the beam is then determined for different conditions, including and arbitrary propagation time of excitation between the supports. Results of the analysis are applied to an example structural system which can model segments of piping systems in nuclear power plants.

80-1595

Global Bending Response Analysis of Elastic and Viscoplastic Nuclear Shipping Cask Structures Subjected to Impact Loading

R.C. Shieh

Transportation Branch, U.S. Nuclear Regulatory Commission, Washington, D.C. 20555, J. Pressure Vessel Tech., Trans. ASME, 102 (1), pp 33-39 (Feb 1980) 9 figs

Key Words: Energy absorption, Shipping containers, Nuclear reactor components, Beams, Rotatory inertia effects, Transverse shear deformation effects, Impact response (mechanical)

Within the framework of lumped mass upgraded beam theory in which rotatory and elastic shear deformation effects are considered, the title analysis is made for the case of large realistic lead-shielded, cylindrical stainless steel shipping casks equipped with end impact limiters. A computerized study developed elsewhere for the dynamic response analysis of elastic and elastic/viscoplastic beams and frames is first extended to include shear deformation and rotatory inertia effects and subsequently used in the cask impact response analysis study. Three types of impact limiter reaction force pulses are considered and three simplified analysis techniques (i.e., quasi-static, dynamic amplification factor and elementary beam analysis techniques) used in shipping cask design are evaluated. In particular, effects of shear deformation and rotatory inertia on impact responses and strain rate sensitivity effects on inelastic dynamic cask response behavior are studied. Appropriate guidelines are formulated for general use of these techniques in impact design analysis; and treating strain rate sensitivity effects on material strength properties in conjunction with use of elastic, limit and elastic-plastic design analysis methods.

CYLINDERS

80-1596

Fluctuating Response of Circular Cylinders in Small Groups in Fluid Flow - Discussion and Guide to Data Available

Engineering Sciences Data Unit Ltd., London, UK, Rept. No. ISBN-0-85679-273-X, 41 pp (1979)
ESDU-79025

Key Words: Cylinders, Circular shells, Cylindrical shells, Multi-beam systems, Chimneys, Pipes (tubes), Fluid-induced excitation

The report discusses the response of cylinders in small groups and the methods of alleviating oscillation problems. It provides a brief description of the content of currently available sources of data to enable users to assess their appropriateness to a particular problem. The information can be used to assess the possibility of flow-induced oscillation problems of, for example, a group of chimney stacks or a multiple pipe run in a chemical plant. This may apply to small groups of up to 6 to 8 cylinders, but excludes specific references to grouped cables or heat-exchanger tube bundles.

COLUMNS

80-1597

Optimal Design of Structures Subjected to Follower Forces

R. Bogacz, H. Irretier, and O. Mahrenholtz
Inst. of Fundamental Tech. Res., Polish Academy of Sciences, ul., Swietokrzyska 11/21 99-049, Warsaw, Poland, Ing. Arch., 49 (1), pp 63-71 (1980) 12 figs, 1 table, 14 refs

Key Words: Columns, Follower forces, Optimum design

The optimal design of columns, consisting of segments with arbitrary thickness and length, subjected to follower forces is considered in this paper. The solution is presented for the case of cross modal interaction of a vibrating system. Since the resulting boundary value problem is nonselfadjoint only approximate solutions are generally possible. The method of the generalized functional and the transfer matrix technique have been used herein, for the solution. As typical examples, the solutions of Beck's, Reut's, Leipholz's and Hauger's column are investigated.

FRAMES AND ARCHES

80-1598

Aseismic Design Procedures for Reinforced Concrete Frames. Seismic Behavior and Design of Buildings, Report No. 1

J.M. Biggs, N.K. Lau, and D. Persinko
Constructed Facilities Div., Massachusetts Inst. of Tech., Cambridge, MA, Rept. No. R79-21, NSF/RA-790205, 90 pp (July 1979)
PB80-104128

Key Words: Frames, Buildings, Reinforced concrete, Seismic design, Seismic response

Twelve reinforced concrete frames are designed for earthquake and gravity loads using three different procedures for determining the seismic design loads. The procedures are: UBC static load approach; modal analysis using inelastic response spectra; and Substitute Structure Method. The validity of each design procedure is evaluated by time-history analysis of each frame to determine maximum local ductility demands due to both real and artificial ground motion.

80-1599

Damping of Frames with Constrained Viscoelastic Layers

D.A. Gasparini, A.D. Chaudhury, and L.W. Curry
Case Western Reserve Univ., Cleveland, OH, ASCE J. Struc. Div., 106 (ST1), pp 115-131 (Jan 1980) 10 figs, 1 table, 17 refs

Key Words: Frames, Viscoelastic damping, Periodic response, Harmonic excitation

The damping of a steel braced frame with a vertical layer of visco-elastic material is quantified by computing steady-state responses to harmonic lateral loadings. Viscoelastic constitutive equations are used to model all materials. It is found that the constrained viscoelastic layer significantly increases the damping of the frame while causing a tolerable loss in lateral stiffness. The static behavior of the frame is found to be analogous to that of coupled shear walls.

80-1600

Seismic Analysis of Some Steel Building Frames

E.P. Popov and V.V. Bertero
Univ. of California, Berkeley, CA, ASCE J. Engr. Mech. Div., 106 (EM1), pp 75-92 (Feb 1980) 21 figs, 27 refs

Key Words: Frames, Steel, Buildings, Seismic design

The design forces specified by standard building codes are smaller than the repeated reversing forces that can be expected to act on a structure during a major earthquake. These large overloads cause the critical elements of a structure to behave inelastically, resulting in large deformations. In this paper, the state-of-the-art in appraising the inelastic cyclic behavior for three different types of structural steel frames is examined. First, the special features in the analysis of the most widely used moment-resisting frames are considered. This is followed by a review of conventional concentrically braced frames. The paper concludes with comments on a novel bracing system in which the braces are deliberately made eccentric with respect to the beam-column joints.

PANELS

80-1601

Development of Stability Methods for Application to Nonlinear Aeroelastic Optimization

R.F. Taylor

Research Inst., Dayton Univ., Dayton, OH, Rept. No. UDR-TR-79-64, AFFDL-TR-79-3114, 189 pp (July 1979)
AD-A077 851/4

Key Words: Stability, Nonlinear systems, Panels, Flutter, Optimization

An approximate procedure is developed which determines efficiently and accurately the amplitude-dependent stability of nonlinear systems. This new procedure, which is referred to as the 'method of imposed disturbances,' is shown to be especially applicable to studies of the sensitivity of nonlinear aeroelastic systems to changes in design variables. Emphasis is placed on airfoil and panel flutter instabilities in aerodynamically nonlinear flow. To develop the theory, a modified form of the van der Pol oscillator equation and of the Lewis servomechanism equation are studied. Based on the principle of conservation of energy in a limit cycle, approximate closed-form expressions are developed which relate the loading and the limit amplitude to system design variables. Results are compared to solutions obtained by numerical integration.

PLATES

(Also see No. 1657)

80-1602

Response of a Double Tube Sheet Structure to Hydraulic Pressure Transients

W.F. Yau

Savannah River Lab., DuPont de Nemours (E.I.) and Co., Aiken, SC, Rept. No. DP-MS-78-73, 15 pp (1979)
N80-11519

Key Words: Nuclear reactor components, Plates, Hole-containing media, Dynamic response, Hydrodynamic excitation

A general procedure was developed to analyze complex tubesheet structures under dynamic loading conditions. The top shield of a Savannah River Plant production reactor is a stainless steel box structure perforated by tubular conduits. It supports the hanging fuel assemblies and the weight of the reactor superstructure. During normal reactor operation the top shield and the fuel assemblies are submerged in water coolant. For a postulated transient induced by a loss-of-coolant, a loading profile was constructed that considered reduction of buoyancy, rapid pressure changes due to generation and condensation of steam, and vacuum force on one side following condensation. Dynamic responses to such a loading are analytically represented by linear combinations of natural models that satisfy a fourth-order equation of motion. Localized stress magnification in the tube-sheets of the structure is determined according to the theory of perforated plates.

80-1603

Flutter of a Plate-Like Member in Horizontal Fluctuating Flow

E. Simiu and R.H. Scanlan

National Engrg. Lab., National Bureau of Standards, Washington, D.C., Engrg. Structures, 1 (4), pp 207-210 (July 1979) 1 fig, 2 tables, 13 refs

Key Words: Plates, Flutter, Bridges, Fluid-induced excitation

The method for the investigation of the aerodynamic stability of a thin plate in horizontally fluctuating flow is considered for use in the analysis of bridge flutter in turbulent flow. The assumption that the self-excited lift and moment correspond to a harmonic motion results in a model of the behavior of the plate that is not 'exact.' Thus, the stability analysis procedure presented does not provide definitive evidence on the aeroelastic behavior of the plate and is viewed as a preliminary approach.

80-1604

Transient Acoustic Radiation from Elastic Plates

S.M. Sengerdy

Applied Res. Lab., Pennsylvania State Univ., University Park, PA, Rept. No. ARL/PSU/TM-79-50, 112 pp (Apr 1979)
AD-A076 772/3

Key Words: Plates, Elastic waves

An expression for the acoustic radiated pressure emanating from an infinite elastic plate excited by a unit impulse load for different observation angles and distances is obtained analytically.

80-1605

The Steady State Response of a Mindlin Annular Plate of Varying Thickness

T. Irie, G. Yamada, and S. Aomura

Dept. of Mech. Engrg., Hokkaido Univ., North 13, West 8, Sapporo 060, Japan, Intl. J. Mech. Sci., 22 (2), pp 99-107 (1980) 3 figs, 2 tables, 12 refs

Key Words: Plates, Variable cross section, Periodic response, Transfer matrix method

The steady state response of an internally damped Mindlin plate of radially varying thickness to sinusoidally varying force is determined by the transfer matrix approach. The method is applied to free-clamped annular plates of linearly, parabolically and exponentially varying thickness, which are driven around the free outer edge or driven around a concentric circle of any radius; the driving-point impedance, transfer impedance and force transmissibility of the plates are calculated numerically, and the effects of the varying thickness on them are studied.

80-1606

Analyses of Cross-Ply Rectangular Plates of Bimodulus Material

V.S. Reddy and C.W. Bert
School of Aerospace, Mechanical and Nuclear Engrg., Univ. of Oklahoma, Norman, OK 73019, Rept. No. OU-AMNE-80-1, 109 pp (Jan 1980) 5 figs, 5 tables, 53 refs

Key Words: Plates, Rectangular plates, Layered materials, Composite structures, Free vibration

A differential equation formulation is presented for the equations governing the small-deflection elastic behavior of thick plates laminated of anisotropic bimodulus materials (which have different elastic stiffnesses depending upon the sign of the fiber-direction strains). This study is concerned with the problems of bending due to pressure loading, free vibrations, and thermal expansion of thick plates having finite transverse shear moduli. Large static deflections of thin plates are also analyzed by an approximate technique. A simple scheme is used for determining explicitly the location of the neutral surface which is defined on the basis of fiber-direction strain.

80-1607

Effects of Shear Deformation and Anisotropy on the Thermal Bending of Layered Composite Plates

J.N. Reddy and Y.S. Hsu
School of Aerospace, Mechanical and Nuclear Engrg., Univ. of Oklahoma, Norman, OK 73019, Rept. No. OU-AMNE-79-20, 25 pp (Dec 1979) 5 figs, 3 tables, 16 refs

Key Words: Plates, Rectangular plates, Layered materials, Composite structures, Periodic excitation, Thermal excitation, Finite element technique, Transverse shear deformation effects

A finite-element formulation of equations governing layered anisotropic composite plates subjected to thermal and mechanical loadings is presented. An exact closed-form solution is also presented for simply supported rectangular cross-ply laminated plates under sinusoidal loading to validate the finite element solutions obtained. The finite element results are in good agreement with the closed-form solutions and with the results of others.

80-1608

Free Vibration of Radially Stiffened Annular Plate

T. Irie, G. Yamada, and S. Aomura
Faculty of Engrg., Hokkaido Univ., Sapporo, Japan, Bull. JSME, 23 (175), pp 76-82 (Jan 1980) 4 figs, 1 table, 10 refs

Key Words: Plates, Stiffened plates, Circular plates, Natural frequencies, Mode shapes, Ritz method

The free vibration of radially stiffened annular plates is studied by the Ritz method using a spline function as an admissible function for the deflection of the plates. The method is applied to annular plates with radial stiffeners located at equal angular intervals on both surfaces of the plates. The natural frequencies and the mode shapes of the plates are calculated numerically, and the effects of the stiffeners on them are studied.

80-1609

Dynamic Response of Laminated Plates to Random Loading

M. Witt and K. Sobczyk
Inst. of Civil Engrg., Wroclaw Technical Univ., Poland, Intl. J. Solids Struc., 16 (3), pp 231-238 (1980) 4 figs, 10 refs

Key Words: Plates, Layered materials, Random excitation, Transverse shear deformation effects, Rotatory inertia effects

The subject of this paper is the response of laminated plates in cylindrical bending to random dynamic loading. The analysis makes use of the theory of laminated plates which includes the effect of transverse shear deformation and rotary inertia. A random loading is characterized by a weakly stationary stochastic process. The general formulae for correlation function (and variance) of vertical displacement

of a plate are obtained and the numerical results are provided for the assumed (exponential) form of correlation function of random loading. Assuming that the random loading is gaussian the results of calculations of the average number of crossings of a given level by the random displacement field are also provided. The results are compared with these obtained using the classical Kirchhoff and Mindlin theory for elastic homogeneous plates.

80-1610

Vibration of Plates of Various Geometries

E.G. Williams

Appl. Res. Lab., Pennsylvania State Univ., University Park, PA, Rept. No. ARL/PSU/TM-79-130, 157 pp (June 17, 1979)

AD-A076 185/8

Key Words: Plates, Mechanical admittance

Point driven, flat, thin aluminum plates of various geometries with free boundaries are studied. The mean of the driving point admittance is predicted over a wide frequency range at any point on these plates and compared to experimental results. Measured loss factors for these free plates were used in the theoretical models. The actual admittance versus frequency for a center driven rectangular plate was predicted.

SHELLS

(Also see Nos. 1515, 1596, 1628)

80-1611

Dynamic Response of a Cylindrical Shell in a Potential Fluid

G.E. Cummings and H. Brandt

Lawrence Livermore Lab., Univ. of California, Livermore, CA 94550, J. Appl. Mech., Trans ASME, 46 (4), pp 772-778 (Dec 1979) 3 figs, 1 table, 26 refs

Key Words: Cylindrical shells, Shells, Submerged structures, Numerical analysis, Natural frequencies, Mode shapes, Experimental data, Nuclear reactor components

A numerical solution technique is presented for determining the dynamic response of a thin, elastic, circular, cylindrical shell of constant wall thickness and density, in a potential fluid. The shell may be excited by any radial forcing function with a specified time history and spatial distribution.

80-1612

Stability of Elastic, Cylindrical Shells Via Liapunov's Second Method

H.H.E. Leipholz

Dept. of Civil Engrg., Solid Mechanics Div., Univ. of Waterloo, Waterloo, Ontario, N2L 3G1, Canada, Ing. Arch., 49 (1), pp 7-14 (1980) 2 figs, 6 refs

Key Words: Shells, Cylindrical shells, Stability, Lyapunov's method

In this paper, Liapunov's Second Method in the version of Movchan, Knops, and Wilkes is applied to the stability problem of the circular, cylindrical shell with fixed ends. For a fairly general and practically important loading condition it is shown that certain conditions with regard to the load intensity and to the magnitude of damping warrant stability in the sense of a general norm. In the case of axisymmetric loading, which occurs for example in a silo, the stability is a uniform, pointwise one concerning the deflection.

80-1613

On the Velocity Induced by a Vortex Elliptic Cylinder

M.F. George

Dept. of Mech. Engrg., Univ. of Newcastle, Newcastle-upon-Tyne, UK, J. Ship Res., 24 (1), pp 1-7 (Mar 1980) 1 fig, 6 tables, 5 refs

Key Words: Fluid induced excitation, Cylindrical shells, Shells, Ducts

Exact analytic expressions are presented for the induced velocity components at any field point due to a single vortex ellipse and due to a vortex elliptic cylinder of uniform strength with a finite and a semi-infinite length. The elliptic cylinder is assumed to deviate very little from the reference circular cylinder. Comparison is made between the derived expressions and those due to a semi-infinite vortex circular cylinder, and sample calculations are presented. This investigation has a direct application to the case of nonaxisymmetric annular aerofoils of elliptic cross sections.

80-1614

Dynamic Plastic Response of Cylindrical Shells Under Gaussian Impulse

S.A. Ramu and K.J. Iyengar

Dept. of Civil Engrg., Indian Inst. of Science, Bangalore, India, J. Ship Res., 24 (1), pp 24-30 (Mar 1980) 10 figs, 6 refs

Key Words: Cylindrical shells, Shells, Impact shock, Submarines

The determination of the inelastic response of cylindrical shells under general impulsive loads is of relevance to marine structures such as submarines, in analyzing their slamming damages. The present study is concerned with the plastic response of a simply supported cylindrical shell under a general axisymmetric impulsive load. The impulsive load is assumed to impart an axisymmetric velocity to the shell, with a Gaussian distribution along the longitudinal axis of the shell. A simplified Tresca yield condition is used. The shell response is determined for various forms of impulses ranging from a concentrated impulse to a uniform impulse over the entire length of the shell. Conclusions about the influence of geometry of the shell and the spatial distribution of impulse on the plastic behavior of cylindrical shells are presented.

80-1615

Free Vibrations of Flat Cylinder Shells

F.A. Emmerling and R.A. Kloss

Hochschule der Bundeswehr, Munchen, W. Germany, Forsch. Ingenieurw., 45 (6), pp 182-188 (1979) 7 figs, 11 refs

(In German)

Key Words: Shells, Cylindrical shells, Free vibration

Based upon the Donnell's equations for the flat isotropic cylinder shell two solutions are given to separate the partial differential equations without considering the tangential inertia term. Both ways - introduction of a stress function or displacement function - lead to the same 8th-order differential equation. Exact solutions, using the displacement function are given for the free vibrations of shell segments, which are simply supported on opposite boundaries parallel to the generating lines of the shell.

80-1616

Response of a Circular Cylindrical Shell to Disturbances in a Half-Space

N.M. El-Akily

Ph.D. Thesis, Univ. of Colorado, Boulder, CO, 206 pp (1979)

UM 8002971

Key Words: Shells, Circular shells, Periodic response

The problem of determining the steady-state dynamic response of a circular cylindrical shell to disturbances in a half-space has been solved in this thesis. Both the shell and the surrounding medium are assumed to be linearly elastic, isotropic and homogeneous and the shell is assumed to be in welded contact with the surrounding medium. Due to the nonseparable nature of the problem, exact solutions are impossible to obtain. Thus, the object of this thesis is to present approximate solutions for the response of the shell. As a limiting case of the shell, the solution for the cavity is also presented. In the latter case, numerical results for the displacement amplitude in the far field have been obtained.

80-1617

Explicit High-Order Finite-Difference Analysis of Rotationally Symmetric Shells

T.A. Smith

U.S. Army Missile Command, Redstone Arsenal, AL, AIAA J., 18 (3), pp 309-317 (Mar 1980) 6 figs, 2 tables, 6 refs

Key Words: Shells, Finite difference technique

The system of equations for the analysis of rotationally symmetric shells subjected to time-dependent loadings and boundary conditions has been formulated with the transverse, meridional, and circumferential displacements as the dependent variables in the field equations. Inertia forces are considered in each of the three coordinate directions of the shell.

80-1618

Cooling Towers Using Measured Wind Data

P.K. Basu and P.L. Gould

Dept. of Civil Engrg., Washington Univ., St. Louis, MO, ASCE J. Struc. Div., 106 (ST3), pp 579-600 (Mar 1980) 20 figs, 1 table, 28 refs

Key Words: Towers, Cooling towers, Shells, Wind-induced excitation, Experimental data

The purpose of this study is to collect and interpret the results of full-scale wind-pressure measurements that are available for hyperbolic cooling towers and to determine the

corresponding displacements and forces in the prototype tower through finite element analysis. In some cases the time intervals for which the pressures were recorded were too long to reflect any dynamic response and static analysis is sufficient. However, in two more recent studies a shorter time interval was used and a dynamic analysis was thought to be appropriate. The main emphasis of this paper was directed towards the elucidation of a time-history analysis method that will have value for the prediction of the structural response of prototype hyperbolic cooling towers due to the measured loadings with a view towards the eventual inclusion of nonlinearities. Also, some dynamic response parameters in the form of amplification and gust factors are calculated using limited ranges of the available time records and some simplifying assumptions necessitated by available resources.

80-1619
Wind Loading and Response of Cooling Towers

N.J. Sollenberger, R.H. Scanlan, and D.P. Billington

Princeton Univ., Princeton, NJ, ASCE J. Struc Div., 106 (ST3), pp 601-621 (Mar 1980) 12 figs, 3 tables, 24 refs

Key Words: Towers, Cooling towers, Shells, Wind-induced excitation

The paper considers wind loadings on cooling towers from both a static and dynamic point of view. Field measurements of wind pressure on full-scale towers provide the main basis for study, and the paper includes a review of how measurements were taken, an interpretation of field data for quasi-static designs, and one suggested procedure for applying field data to a more complete dynamic analysis of the tower response in gusting wind.

80-1620
Wind Loading on Cooling Towers

J. Armitt

Central Electricity Res. Labs., Leatherhead, Surrey, UK, ASCE J. Struc Div., 106 (ST3), pp 623-641 (Mar 1980) 12 figs, 1 table, 10 refs

Key Words: Towers, Cooling towers, Shells, Wind-induced excitation, Wind tunnel tests

A wind-tunnel technique for the assessment of wind induced stresses in cooling tower shells has been developed. It includes simulation of the atmospheric wind and aeroelastic models of the towers under test as part of a complete site model. It is shown that the simulation of the steady and fluctuating wind loadings and the dynamic properties of the models are in good agreement with results from full-scale towers. The predictions of wind speeds for failure of the tower shell given by the method are shown to be in good agreement with full-scale evidence. Stresses in cooling tower shells are sensitive to changes in wind loading distribution arising from aerodynamic interactions in complex groups of towers. If the resonant frequencies of the shell are low enough, vibration arising from turbulence produced by the wakes of buildings and other cooling towers can produce significant contributions to the stresses.

80-1621
Wind Effects on Cooling-Tower Shells

H. Niemann

Ruhr-Universitat Bochum, Bochum, Federal Republic of Germany, ASCE J. Struc Div., 106 (ST3), pp 643-661 (Mar 1980) 11 figs, 11 refs

Key Words: Towers, Cooling towers, Shells, Wind-induced excitation

The design of natural-draft cooling towers is dominated by wind action. With respect to the response of the structure the wind load may be divided into a static, a quasistatic, and a resonant part. The effect of surface roughness of the shell and of wind profile on the static load is discussed. The quasi-static load may be described by the variance of the pressure fluctuations and their circumferential and meridional correlations. The high-frequency end of the pressure spectra and of the coherence functions are used for the analysis of the resonant response. In general, the resonant response is small even for very high towers. It increases overlinearly with wind velocity. Equivalent static loads may be defined using appropriate gust-response factors. These loads produce an approximation of the behavior of the structure and in general are sufficiently accurate.

RINGS

(Also see No. 1483)

80-1622
Dynamic Structural Model of a Submerged Ring

J.T. Waller, Jr

Naval Postgraduate School, Monterey, CA, 51 pp (Sept 1979)
AD A078 157/5

Key Words: Submerged structures, Rings, Mathematical models, Cavitation noise, Finite element techniques

A dynamic structural model of a submerged ring is developed using trigonometric series. It is constructed for use in conjunction with a finite element fluid model to examine the effects of cavitation on underwater shock loading of a structure. The governing equations and the time integration algorithm used in the model are described. Results predicted by the model are compared to known results. The program listing is given.

PIPES AND TUBES

(Also see Nos. 1509, 1510, 1596)

80-1623

Effects of Shearing Loads and In-Plane Boundary Conditions on the Stability of Thin Tubes Conveying Fluid

J. Tani and H. Doki

Inst. of High Speed Mechanics, Tohoku Univ., Sendai, Japan, J. Appl. Mech., Trans. ASME, 46 (4), pp 779-783 (Dec 1979) 4 figs, 18 refs

Key Words: Stability, Pipes (tubes), Fluid-filled containers, Fourier integrals, Galerkin method

The hydroelastic stability of short, simply supported, thin-walled tubes conveying fluid is examined with an emphasis on the effects of shearing loads and in-plane boundary conditions. The Donnell shell equation is used in conjunction with linearized, potential flow theory. The solution is obtained by using Fourier integral theory and Galerkin's method. It is found that an increase of the shearing load reduces the critical divergence velocity and raises the corresponding number of circumferential waves. A change in the in-plane boundary conditions exerts the significant effect on the critical divergence velocity of short tubes.

80-1624

Response of Water-Filled Thin-Walled Pipes to Pressure Pulses: Experiments and Analysis

C.M. Romander, L.E. Schwer, and D.J. Cagliostro

Poulter Lab., SRI International, Menlo Park, CA 94025, J. Pressure Vessel Tech., Trans. ASME, 102 (1), pp 56-61 (Feb 1980) 14 figs, 6 refs

Key Words: Pipes (tubes), Fluid-filled containers, Interaction: structure-fluid, Pulse excitation

Experiments are performed to verify modeling techniques used in fluid-structure interaction codes that predict the response of liquid-filled piping systems to strong pressure pulses. The experimental and analytical results are discussed in detail and are found to compare favorably.

80-1625

Dynamic Response of an Embedded Pipe Subjected to Periodically Spaced Longitudinal Forces

R. Parnes and P. Weidlinger

Weidlinger Associates, NY, Rept. No. NSF/RA-790202, 34 pp (Aug 1979)

PB80-102932

Key Words: Pipes (tubes), Underground structures, Interaction: soil-structure, Seismic excitation

The dynamic response of pipe systems buried in soil is studied. The degree of interaction between the pipe and surrounding soil as well as the amount of damping is established for pipes subjected to incoherent motion.

80-1626

Buried Pipelines Analysis/Design for Earthquakes

R.R. Pikul

Ph.D. Thesis, Rensselaer Polytechnic Inst., 222 pp (1979)

UM 8004767

Key Words: Pipelines, Underground structures, Seismic design

A methodology is presented for the analysis/design of buried pipelines considering the axial and flexural effects caused by a probable earthquake occurrence. Additional problems due to ground failure characterized by landslides and soil liquefaction are not discussed in detail. The presentation is oriented to the practicing engineering professional and synthesizes the state-of-the-art with current research.

80-1627

Dynamic Testing of Slotted Underdrain Pipe

A.J. Bush, III and R.T. Sullivan

Geotechnical Lab., Army Engineer Waterways Experiment Station, Vicksburg, MS, Rept. No. FHWA/RD-79/501, 141 pp (Feb 1979)

PB80 120090

Key Words: Pipes (tubes), Underground structures, Dynamic tests, Moving loads

This study evaluates the performance of slotted plastic underdrains under full-scale dynamic loadings.

80-1628

Dynamic Propagation of Circumferential Cracks in Two Pipes with Large-Scale Yielding

A.F. Emergy, A.S. Kobayashi, W.J. Love, and A. Jain
Dept. of Mech. Engrg., Univ. of Washington, Seattle, WA 98195, J. Pressure Vessel Tech., Trans. ASME, 102 (1), pp 28-32 (Feb 1980) 9 figs, 26 refs

Key Words: Shells, Pipes (tubes), Cracked media, Crack propagation, Finite difference technique

The dynamic motions of circumferentially oriented, through cracks in two axially pre-stressed pipes were analyzed by a finite-difference shell code in the presence of large-scale yielding. Lacking any dynamic fracture criterion for large-scale yielding, a static ductile fracture criterion based on crack-tip opening angle was used. The importance of a realistic dynamic ductile fracture criterion is underscored.

80-1629

Pressure Transient Analysis in Piping Systems Including the Effects of Plastic Deformation and Cavitation

C.K. Youngdahl, C.A. Kot, and R.A. Valentin
Components Tech. Div., Argonne Nat. Lab., Argonne, IL 60439, J. Pressure Vessel Tech., Trans. ASME, 102 (1), pp 49-55 (Feb 1980) 18 figs, 12 refs

Key Words: Nuclear reactor components, Piping systems, Cavitation, Pulse excitation, Shock wave propagation, Computer programs

Computational methods for analyzing pressure transients in the intermediate heat transport system of a sodium-cooled breeder reactor are being developed at Argonne National Laboratory. The pressure pulses produced by a sodium/water reaction in a steam generator may plastically deform sections of the piping, and wave interactions may then produce cavitation in the system. Both these phenomena have a large effect on the pressure pulses traversing the pipe network and, consequently, on the transient loading on major components.

DUCTS

(Also see No. 1645)

80-1630

Reciprocity Principle in Duct Acoustics

Y. Cho
NASA, Lewis Res. Ctr., Cleveland, OH, Rept. No. NASA-TM-79300; E-250, 23 pp (1979)
N80-12824

Key Words: Ducts, Acoustic properties, Reciprocity principle

Various reciprocity relations in duct acoustics have been derived on the basis of the spatial reciprocity principle implied in Green's functions for linear waves. The derivation includes the reciprocity relations between mode conversion coefficients for reflection and transmission in nonuniform ducts, and the relation between the radiation of a mode from an arbitrarily terminated duct and the absorption of an externally incident plane wave by the duct. Such relations are well defined as long as the systems remain linear, regardless of acoustic properties of duct nonuniformities which cause the mode conversions.

80-1631

A Time Dependent Difference Theory for Sound Propagation in Ducts with Flow

K.J. Baumeister
NASA, Lewis Res. Ctr., Cleveland, OH, Rept. No. NASA-TM-79302; E-254, 38 pp (1979)
N80-12823

Key Words: Ducts, Sound propagation, Finite difference technique, Time dependent parameters

A time dependent numerical solution of the linearized continuity and momentum equation was developed for sound propagation in a two dimensional straight hard or soft wall duct with a sheared mean flow. Example calculations are presented for sound propagation in hard and soft wall ducts, with no flow and plug flow.

80-1632

Time-Dependent Difference Theory for Noise Propagation in a Two-Dimensional Duct

K.J. Baumeister
NASA, Lewis Res. Ctr., Cleveland, Oh, Rept. No

NASA-TM-79298; E-249; AIAA-Paper-80-0098, 13 pp (1979)
N80-12822

Key Words: Ducts, Sound propagation, Sound attenuation, Finite difference technique, Time dependent parameters

A time dependent numerical formulation was derived for sound propagation in a two dimensional straight soft-walled duct in the absence of mean flow. The time dependent governing acoustic-difference equations and boundary conditions were developed along with the maximum stable time increment. Example calculations were presented for sound attenuation in hard and soft wall ducts.

ELECTRIC COMPONENTS

MOTORS

80-1633

Synchronous Motors . . . Avoid Torsional Vibration Problems

E.I. Pollard

Consultant, Elliott Co., Jeannette, PA, Hydrocarbon Processing, 59 (2), pp 97-102 (Feb 1980) 5 figs, 8 refs

Key Words: Motors, Torsional vibration, Vibration control, Design techniques

AC synchronous motors with larger power ratings generate potentially damaging oscillating torques, causing forced torsional vibration of the equipment. An analysis of motor and compressor combination design practices that minimize these problems is presented.

DYNAMIC ENVIRONMENT

ACOUSTIC EXCITATION

(Also see Nos. 1484, 1486, 1487, 1488, 1489, 1490, 1491, 1492, 1494, 1495, 1500, 1501, 1517, 1522, 1523, 1527, 1528, 1540, 1541, 1542, 1543, 1544, 1552, 1553, 1604, 1630, 1631, 1632, 1679, 1682, 1710, 1729, 1736, 1743, 1744)

80-1634

Theory of Scattering from Multilayered Bodies of Arbitrary Shape

J.A. DeSanto

Naval Res. Lab., Washington, D.C. 20375, Wave Motion, 2 (1), pp 63-73 (Jan 1980) 1 fig, 17 refs

Key Words: Elastic waves, Wave diffraction

Green's functions and boundary integral equation methods are used to derive a matrix set of equations for scattering from a multilayered homogeneous elastic body embedded in an infinite elastic material. The surfaces separating the layers have arbitrary shape. The formalism for the three-layer material is derived in detail and generalized to *N*-layers. A matrix factorization method is shown to considerably simplify the computational problem. The relation to the problems of acoustic waves in fluids and electromagnetic waves in a dielectric material is briefly indicated.

80-1635

Scattering of Acoustic Waves by Elastic and Viscoelastic Obstacles Immersed in a Fluid

B.A. Peterson, V.V. Varadan, and V.K. Varadan

Dept. of Engrg. Mech., The Ohio State Univ., Columbus, OH 43210, Wave Motion, 2 (1), pp 23-38 (Jan 1980) 17 figs, 13 refs

Key Words: Elastic waves, Wave diffraction

A scattering or *T*-matrix approach is presented for studying the scattering of acoustic waves by elastic and viscoelastic obstacles immersed in a fluid. A Kelvin-Voigt model is used to obtain the complex elastic moduli of the viscoelastic solid. The *T*-matrix formulation is somewhat complicated because the wave equations and fields are quite different in the solid and fluid regions and are coupled by continuity conditions at the interface.

80-1636

Multiple Scattering of Elastic Waves by Bounded Obstacles

A. Boström

Inst. of Theoretical Physics, S-412 96 Göteborg, Sweden, J. Acoust. Soc. Amer., 67 (2), pp 399-413 (Feb 1980) 32 figs, 36 refs

Key Words: Acoustic scattering, Elastic waves

The transition matrix method for stationary elastic waves is extended to a great class of obstacles characterized by piecewise constant properties.

80-1637

Resonance Theory of Elastic Shear-Wave Scattering from Spherical Fluid Obstacles in Solids

D. Brill, G. Gaunaurd, and H. Überall

U.S. Naval Academy, Annapolis, MD 21402, J. Acoust. Soc. Amer., 67 (2), pp 414-424 (Feb 1980) 9 figs, 29 refs

Key Words: Fluid filled containers, Acoustic scattering, Cavity resonators

Resonance features in shear-wave scattering from spherical fluid-filled cavities in elastic solids are investigated analytically, as contrasted to the observation of resonance effects obtained numerically.

80-1638

Separation of Core Noise and Jet Noise

S.P. Parthasarathy, R.F. Cuffel, and P.F. Massier

Jet Propulsion Lab., California Inst. of Tech., Pasadena, CA, AIAA J., 18 (3), pp 256-262 (Mar 1980) 13 figs, 2 tables, 7 refs

Key Words: Noise source identification, Noise measurement

A method of identification and measurement of core noise and jet noise separately has been developed based on cross-correlation of signals from microphones located at widely separated angles in the far field of a jet. The different coherent properties of core noise and jet noise are used in this method to achieve this separation. Experimental data obtained in a small scale facility are analyzed to demonstrate that this method can be used successfully to separate the mean-square pressures of core noise and jet noise.

80-1639

Studies of the Acoustic Transmission Characteristics of Coaxial Nozzles with Inverted Velocity Profiles, Volume 1

P.D. Dean, M. Salikuddin, K.K. Ahuja, H.E. Plumblee, and P. Mungur

Lockheed-Georgia Co., Marietta, GA, Rept. No. NASA CR-159698, LG79ER0178-V-1, 186 pp (May 1979)

N80-11870

Key Words: Sound transmission, Nozzles

The efficiency of internal noise radiation through coannular exhaust nozzle with an inverted velocity profile was studied. A preliminary investigation was first undertaken to: define the test parameters which influence the internal noise radiation; develop a test methodology which could realistically be used to examine the effects of the test parameters; and to validate this methodology. The result was the choice of an acoustic impulse as the internal noise source in the jet nozzles.

80-1640

A Closed-Form Solution for Noise Contours

E.C. Stewart and T.M. Carson

NASA, Ames Res. Ctr., Moffett Field, CA, Rept. No. NASA-TP-1432, A-7660, 40 pp (Nov 1979)

N80-11869

Key Words: Noise generation, Aircraft noise

An analytical approach for generating noise contours that overcome the difficulties of existing programs is described. This approach is valid for arbitrarily complex paths and reveals the importance of various factors that influence contour shape and size.

80-1641

Ambient Noise Depth-Dependence Models and Their Relation to Low-Frequency Attenuation

D.E. Weston

Appl. Res. Labs., The Univ. of Texas at Austin, Austin, TX 78712, J. Acoust. Soc. Amer., 67 (2), pp 530-537 (Feb 1980) 6 figs, 3 tables, 20 refs

Key Words: Underwater sound, Sound attenuation, Mathematical models

The modeling of low-frequency ambient sea noise levels, and especially their depth dependence is described. It is also *shown how the model is used to examine the mechanisms and magnitudes of low-frequency sound attenuation in the deep ocean.*

80-1642

Underwater Sound Mathematical Model. Theoretical Discussion

R. Bell

Naval Ocean Systems Ctr., San Diego, CA, Rept. No

NOSC/TD-272, 26 pp (Aug 15, 1979)
AD-A075 945/6

Key Words: Underwater sound, Mathematical models

The physical phenomena which affect performance measurements at SACS (Sensor Accuracy Check Site) must in part be studied through the use of an acoustic mathematical model. This document derives equations for the summation of two independent acoustic waves at a point receiver, derives equations for the summation of multiple acoustic waves at a point receiver, defines a three-dimensional source cardioid, and develops general equations for the summation at a point receiver of direct and reflected path acoustic waves emanating from multiple cardioid sources.

80-1643

A Study on Drum Brake Noise by Holographic Vibration Analysis

A. Felske, G. Hoppe, and H. Matthai

Volkswagenwerk AG, Wolfsburg, W. Germany, SAE Paper No. 800221, 24 pp, 30 figs, 1 table, 24 refs

Key Words: Brakes (motion arresters), Vibration source identification, Noise source identification, Holographic techniques, Measurement techniques, Noise reduction

Vibration sources on drum brake components were obtained by holographic and classical techniques and the results are used to develop methods for suppression of brake noise.

SHOCK EXCITATION

(Also see Nos. 1478, 1503, 1504, 1506, 1507, 1511, 1518, 1519, 1524, 1545, 1549, 1550, 1551, 1560, 1563, 1564, 1566, 1567, 1586, 1598, 1600, 1626, 1665, 1681, 1707, 1712, 1722, 1723, 1732, 1741, 1742)

80-1644

A Variational Principle for Steady Homenergic Compressible Flow with Finite Shocks

A.R. Manwell

Dept. of Aeronautics and Astronautics, The Univ., Southampton, UK, Wave Motion, 2 (1), pp 83-95 (Jan 1980) 12 refs

Key Words: Shock wave propagation, Fluid mechanics, Variational methods

Hamilton's principle for a general time-dependent motion of a perfect compressible fluid under, effectively, no applied forces is used to obtain a variational principle for steady homenergic flows. This principle being applied to plane flows with a shock line, we find the Hugoniot shock relations and one other condition.

80-1645

Analysis of the Separation Due to Shock Wave-Turbulent Boundary Layer Interaction in Transonic Flow

J. Delery

Office National d'Etudes et de Recherches Aerospatiales, Paris, France, In: Its LaRech. Aerospatiale, Bi-monthly Bull. No. 1978-6, pp 23-45 (Sept 1979) Engl. transl. from La Rech. Aerospatiale, Bull. Bimestriel, Paris, No. 1978-6, pp 305-320 (Nov/Dec 1978)
N80-12031

Key Words: Shock wave propagation, Ducts, Holographic techniques, Lasers, Interferometers

Holographic interferometry and laser velocimetry were used in conjunction to analyze the flow resulting from the interaction between a shock and the boundary layer in a two-dimensional transonic duct.

80-1646

Nonlinear Hydrodynamic Shock Propagation Analysis by the Finite Element Method

J.E. Jackson and T.L. Cost

Dept. of Mech. Engrg., Clemson Univ., Clemson, SC 29631, Intl. J. Engr. Sci., 18 (2), pp 351-356 (1980) 3 figs, 1 table, 15 refs

Key Words: Shock wave propagation, Finite element technique

The method of weighted residuals is used in conjunction with the finite element method to solve the nonlinear hydrodynamic field equations. The algebraic equations which result from the finite element approximations were solved using the Standard Newton-Raphson method, the Modified Newton-Raphson method, the Self-Correcting Incremental Method, and the Method of Successive Substitutions. Also, the Gear 2-Step and 3-Step temporal operators were employed along with the Park temporal operator and a first order backward difference method to obtain the transient response.

80-1647

Probabilistic Earthquake Energy Spectra Equations

P.-T.D. Spanos

Univ. of Texas at Austin, TX, ASCE J. Engr. Mech. Div., 106 (EM1), pp 147-159 (Feb 1980) 34 refs

Key Words: Ground motion, Earthquake response, Simulation, Random excitation, Spectral energy distribution techniques, Stochastic processes

The response of a lightly damped linear structure to a broad-band nonstationary random process with evolutionary spectral density is considered. A first-order stochastic differential equation governing the time evolution of the structural energy is derived. Utilizing this equation a readily applicable equation for the determination of the mean energy is obtained. Nonstationary random processes proposed in the literature for the simulation of earthquakes are examined in detail, and equations for the construction of probabilistic energy spectra are presented.

80-1648

Probabilistic Site-Dependent Response Spectra

A.S. Kiremidjian and H.C. Shah

Dept. of Civil Engrg., Stanford Univ., Stanford, CA, ASCE J. Struc. Div., 106 (ST1), pp 69-86 (Jan 1980) 5 figs, 3 tables, 14 refs

Key Words: Earthquake prediction, Seismic response spectra, Response spectra

A method is developed for obtaining probabilistic soil-dependent pseudo-absolute acceleration response spectra. The resulting spectra are consistent with the acceptable design risk level from future earthquakes at a specific site. Structural exposure to future earthquakes is obtained in terms of probabilities of peak ground acceleration values that can occur at firm grounds, intermediate soils, and soft soil sites.

VIBRATION EXCITATION

(Also see Nos. 1485, 1705, 1724)

80-1649

Eigensolution for Large Structural Systems with Substructures

J.S. Arora and D.T. Nguyen

Div. of Materials Engrg., The Univ. of Iowa, Iowa City, IA, Intl. J. Numer. Methods Engr., 15 (3), pp 333-341 (Mar 1980) 2 figs, 1 table, 9 refs

Key Words: Natural frequencies, Mode shapes, Finite element technique, Substructuring methods

A method for calculating natural frequencies and mode shapes of large structural systems with substructures and the subspace iteration is developed. The method uses only substructural stiffness matrices and the mass matrix for each finite element of the system. The mass matrix for the entire structure or any of its substructures need not be computed. However, efficiency of the method is improved when mass matrix for the entire structure is computed and saved in the computer core.

80-1650

Forced Vibrations in an Unsymmetric Piecewise-Linear System Excited by General Periodic Force Functions

S. Maezawa, H. Kumano, and Y. Minakuchi

Faculty of Engrg., Yamanashi Univ., Japan, Bull. JSME, 23 (175), pp 68-75 (Jan 1980) 6 figs, 6 refs

Key Words: Forced vibration, Linear systems, Periodic excitation, Fourier series

Forced vibrations in an unsymmetric piecewise-linear system excited by general periodic force functions are discussed. The system has no damping. The superharmonic resonances up to the second order are analyzed by means of a perfect Fourier series method. As the simplest example, the exciting forces are assumed to be of even function with the second higher harmonics only. The theoretical resonance curves are computed by a digital computer and are compared with the results obtained by an analog computer. They show a fairly good agreement.

80-1651

Vibrations of Piezoelectric Crystals

M.C. Dökmeci

Istanbul Teknik Üniversitesi, P.K., 9, Gümüssuyu, Istanbul, Turkey, Intl. J. Engr. Sci., 18 (3), pp 431-448 (1980) 271 refs

Key Words: Vibration response, Piezoelectricity

The fundamental differential equations of the linear theory of apolar and nonrelativistic, thermopiezoelectricity and also its variational description are presented. Representative recent applications to vibrations and waves as well as to flexure and fracture are reviewed for 1- and 2-dimensional piezoelectric crystals of finite and infinite extents, and of

uniform and variable cross-sections or thickness, with full and partial coatings. Further needs of research in this field are briefly indicated.

80-1652
Torsional Wave Motion of a Finite Inhomogeneous Piezoelectric Cylindrical Shell

K.V. Sarma
Dept. of Mathematics, PSG College of Arts & Science, Coimbatore 641-014, India, Intl. J. Engr. Sci., 18 (3), pp 449-454 (1980) 3 refs

Key Words: Shells, Piezoelectricity, Torsional vibrations

Torsional oscillations of a finite right circular cylindrical shell of inhomogeneous piezoelectric material of (622) crystal class under a time dependent electric potential on the boundary is investigated. The inhomogeneity is restricted to the variations of density and other physical constants of the medium as a certain power of the radial distance. Under certain conditions, the amplitudes of torsional oscillations are found to be high for small values of the inner radius of the shell.

MECHANICAL PROPERTIES

DAMPING

(Also see Nos. 1497, 1599)

80-1653
The Effects of Strain and Temperature on the Dynamic Properties of Elastomers

M.S. Darlow and A.J. Smalley
Mechanical Technology, Inc., Latham, NY 12110, J. Mech. Des., Trans. ASME, 102 (1), pp 45-53 (Jan 1980) 17 figs, 3 tables, 8 refs

Key Words: Dampers, Elastomeric dampers, Thermal excitation, Dynamic response

Dynamic properties of elastomers as a function of strain and ambient temperature were analyzed and tested experimentally. The temperature distribution in the elastomer samples was measured during the tests. These measured properties were compared with analytical predictions based on a visco-elastic model designed to take into account the self-heating of the materials as a function of strain. The test method used was well-established base excitation resonant mass technique. The specimens tested were two cylindrical button compression specimens and a shear specimen.

80-1654
Pressurized Oil Squeeze Film Dampers

A.K. Stiffler
Dept. of Mech. Engrg., Mississippi State Univ., Mississippi State, MS 39762, J. Lubric. Tech., Trans. ASME, 102 (1), pp 41-47 (Jan 1980) 18 figs, 13 refs

Key Words: Dampers, Squeeze-film dampers, Rotors (machine elements)

A pressurized oil squeeze film damper supporting a rigid rotor mounted in antifriction bearings is investigated. Orifice and inherent feed inlets are examined, and it is shown that the clearance determines the inlet resistance for a groove or slot. The film stiffness and damping forces are determined as a function of the restrictor coefficient, rotor unbalance speed and the supply pressure using the short bearing approximation. These forces are related to the system transmissibility. A design methodology for low transmissibilities is presented.

80-1655
Decoupler Pylon: A Simple, Effective Wing/Store Flutter Suppressor

W.H. Reed III, J.T. Foughner, Jr., and H.L. Runyan, Jr.
NASA Langley Res. Ctr., Hampton, VA, J. Aircraft, 17 (3), pp 206-211 (Mar 1980) 12 figs, 9 refs

Key Words: Active control, Aircraft wings, Wing stores, Flutter

As an alternative to alleviating wing/store flutter by conventional passive methods or by more advanced active control methods, a quasi-passive concept referred to as the decoupler pylon is investigated which combines desirable features of both methods. Passive soft-spring/damper elements are used to decouple wing modes from store pitch modes, and a low-power control system maintains store alignment under changing mean loads. It is shown by analysis and wind tunnel tests that the decoupler pylon provides substantial increase in flutter speed and makes flutter virtually insensitive to inertia and center-of-gravity location of the store.

80-1656

Automatic Active Control of Structures

M. Abdel-Rohman and H.H. Leipholz

Univ. of Waterloo, Waterloo, Ontario, Canada, ASCE J. Struc. Div., 106 (ST3), pp 663-677 (Mar 1980) 16 figs, 15 refs

Key Words: Active control, Active damping, Bridges

A closed-loop control system for a simplified structural model is designed, neglecting those factors which complicate the design. The efficiency of the designed control system is then checked afterwards by considering those factors which have been neglected previously. The design may be revised if the controlled response, considering the neglected factors, is not acceptable.

FATIGUE

(Also see Nos. 1572, 1574, 1583, 1584, 1695)

80-1657

Development of a Realistic Stress Analysis for Fatigue Analysis of Notched Composite Laminates

E.A. Humphreys and B.W. Rosen

Materials Sciences Corp., Blue Bell, PA, Rept. No. NASA-CR-159119, 90 pp (May 1979)

N80-11146

Key Words: Fatigue life, Composite structures, Layered materials, Hole-containing media, Plates

A finite element stress analysis wich consists of a membrane and interlaminar shear spring analysis was developed. This approach was utilized to model physically realistic failure mechanisms while maintaining a high degree of computational economy. The accuracy of the stress analysis predictions is verified through comparisons with other solutions to the composite laminate edge effect problem. The stress analysis model was incorporated into an existing fatigue analysis methodology and the entire procedure computerized. A fatigue analysis is performed upon a square laminated composite plate with a circular central hole. A complete description and users guide for the computer code FLAC (Fatigue of Laminated Composites) is included as an appendix.

80-1658

A Probabilistic Model of Size Effect in the Fatigue Strength of Rounds in Bending and Torsion

C.R. Mischke

Dept. of Mech. Engrg., Iowa State Univ., Ames, IA 50011, J. Mech. Des., Trans. ASME, 102 (1), pp 32-37 (Jan 1980) 7 figs, 4 tables, 12 refs

Key Words: Rods, Shafts, Fatigue life, Flexural vibration, Torsional excitation

The use of a probabilistic premise to establish the relation of size to the attenuation of endurance strength in rounds, such as shafts subjected to bending or torsion is investigated. The method allows the designer to construct the appropriate expression for Marin fatigue strength reduction factor, k_b, directly from fatigue tests that have been ordered. For probabilistic design procedures, the mean and standard deviation of the Marin fatigue strength reduction factor are required, and the method described allows to make these estimates.

80-1659

Analysis of Fatigue Damage in Composite Laminates

K.L. Reifsnider and A. Talug

Engrg. Sci. and Mechanics Dept., Virginia Polytech. Inst. and State Univ., Blacksburg, VA 24061, Intl J. Fatigue, 2 (1), pp 3-11 (Jan 1980) 16 figs, 22 refs

Key Words: Layered materials, Composite structures, Fatigue life

Development in laminated plates under cyclic (fatigue) loading is investigated. The philosophy is based on the discovery of a 'characteristic damage state' in such plates which forms independently of load history, and is determined only by the properties of the laminae, their orientations, and their stacking sequence. The detailed nature of this characteristic damage state, the nature of its formation, and its influence on strength, life and stiffness is discussed.

80-1660

The Inclusion of Criteria and Procedures of Structural Fatigue Strength Assessment in the Design Process

W. Beitz and R. Haibach

Technische Univ., Berlin, W. Germany, Rept. No. ICAF-1092, 20 pp (Oct 12, 1978)

N79-33495

Key Words: Structural members, Fatigue life

The various procedures for assessing the fatigue strength of structural components are discussed with reference to the particular stages of the design process.

80-1661
Fatigue Behavior of Exhaust Valve Alloys
D.R. Jones
TRW Valve Div., SAE Paper No. 800315, 16 pp, 11 figs, 5 tables, 10 refs

Key Words: Engine valves, Exhaust systems, Engines, Internal combustion engines, Fatigue (materials), Environmental effects

The fatigue properties of internal combustion engine exhaust valve alloys are reviewed. Examples of typical exhaust valve fatigue failures are shown along with an explanation of the factors leading to these failures. The results of laboratory engine tests designed to duplicate underhead fatigue failures and evaluate the effect of valve design are discussed. The elevated temperature fatigue strength of common exhaust valve alloys in plain air and corrosive environments is presented along with a method to determine fatigue crack initiation and propagation rates. The results of scanning electron microscope studies correlate well with the experimentally determined crack growth rates.

ELASTICITY AND PLASTICITY

(Also see No. 1737)

80-1662
Applications of Generalized Derivatives to Viscoelasticity
R L Bagley
Rept No AFML-TR-79-4103, 119 pp (Nov 1979)

Key Words: Mathematical models, Viscoelastic properties, Constitutive equations, Equations of motion

Generalized derivatives of fractional order are used to construct stress-strain constitutive relations for viscoelastic materials, based on the observed sinusoidal behavior of the materials. The non-periodic behavior of one material is observed in the laboratory and compares favorably with the non-periodic behavior of the material predicted by its generalized derivative constitutive relation. Having established that the generalized derivative constitutive relation is an appropriate mathematical model for the general motion of at least one viscoelastic material, the tools for the analysis of structures of engineering interest are put forward. In particular, attention is focused on a finite element formulation of and solutions to the equations of motion for structures containing elastic and viscoelastic components.

80-1663
A Note on Some Dynamic Crack Problems in Linear Viscoelasticity
C. Atkinson
Dept. of Mathematics, Imperial College, London, UK, Arch. Mech., 31 (6), pp 829-849 (1979), 10 refs

Key Words: Crack propagation, Viscoelastic media

The problem of a semi-infinite crack propagating at constant speed in a linear viscoelastic medium under plane-strain conditions and with particular time-dependent loadings is considered. Explicit results for crack tip stresses and displacements are given for short and long times.

80-1664
Transient Wave Propagation Normal to the Layering of a Finite Layered Medium
I. Mukunoki and T.C.T. Ting
Dept. of Materials Engrg., Univ. of Illinois at Chicago Circle, Chicago, IL 60680, Intl. J. Solids Struc., 16 (3), pp 239-2251 (1980) 6 figs, 17 refs

Key Words: Wave propagation, Layered materials, Viscoelastic media, Elastic media

Plane wave propagation in the direction normal to the layering of a periodically layered medium is studied. A period consists of two layers of homogeneous, isotropic, linear elastic or viscoelastic materials. The layered medium is of finite extent and hence consists of a finite number of layers. A theory is presented by which the layered medium is replaced by an "equivalent" linear homogeneous viscoelastic material such that the stress or the velocity in the latter and in the layered medium are identical at the centers of the alternate layers. Transient waves in the layered medium are then obtained by solving the transient waves in the "equivalent" homogeneous viscoelastic medium. Solutions at points other than the centers of the alternate layers are also presented. Numerical examples are given for transient waves in an elastic layered medium due to a step load applied at one of the boundary while the other boundary is fixed. Comparisons with the exact solutions by the ray theory show that the present theory can predict very satisfactorily transient waves in a finite layered medium.

EXPERIMENTATION

MEASUREMENT AND ANALYSIS

(Also see Nos. 1491, 1535, 1643, 1697)

80-1665

Overcoming Traditional Problems of Explosion Measurement in Quarries with Electronic Transient Recorders

K. Huggett
Data Laboratories, Ltd., Noise and Vib. Control, 11 (1), pp 8-10 (Jan 1980) 3 figs

Key Words: Measuring instruments, Mines (excavations), Explosions, Ground motion

A transient recorder Datelab DL901, used for monitoring and measuring vibrations caused by blasting in quarries, is described.

80-1666

Digital Fluidic Output Force Balance Accelerometer

J.V. Johnston
Dept. of the Army, Washington, D.C., PAT-APPL-6-011 480, 7 pp (Feb 12, 1979)

Key Words: Accelerometers, Measuring instruments

A digital fluidic output accelerometer is described. It has a proportional fluid amplifier for balancing forces acting on a mass which is rotatably mounted on air bearing means and has a digital fluidic output which produces digital signals that are proportional to acceleration of device.

80-1667

Measurement of Frequency Response of a Piezoelectric Transducer Using an Acousto-optic Modulator

C. Man and P. Cerez
Laboratoire de l'Horloge Atomique, Equipe de Recherche du CNRS, Batiment 221, Universite Paris-Sud, 91405 Orsay, France, J. Phys. E. (Sci. Instr.), 13 (2), pp 157-159 (Feb 1980) 2 figs, 6 refs

Key Words: Measuring instruments, Piezoelectric transducers, Transducers

The frequency behaviour of piezoelectric transducers (PZTS) is analyzed using a phase-modulation technique involving an acousto-optic modulator. The results give useful information on critical elements of laser stabilization loops.

80-1668

Test Automation for Tire Force and Moment Measurement

G.L. Hall, R.R. Ackerman, and J.F. Siegfried
Firestone Tire & Rubber Co., Akron, OH, SAE Paper No. 800244, 8 pp, 9 figs, 5 refs

Key Words: Tires, Tire characteristics, Cornering effects, Alignment, Rolling friction, Measurement techniques, Computer-aided techniques

A computerized apparatus and test procedures for determining cornering force, self-aligning torque and rolling resistance of tires along with a complex hydraulic control system is described.

80-1669

A Tread-Deflection Measurement System Utilized in Tire Hydroplaning Studies

W. Benson, J.J. Henry, and W.S. Adams
U.S. Coast Guard Academy, New London, CT, SAE Paper No. 800243, 12 pp, 9 figs, 9 refs

Key Words: Measuring instruments, Tires, Transient response

The tread-deflection measurement system was developed to investigate the transient response of a sliding tire as it encounters a change in free waterfilm thickness. The system is capable of measuring transient deflection changes in the contact region of a tire within one millisecond intervals.

80-1670

Calibration of Chassis Dynamometers for Emission- and Fuel Economy Testing Using Wheel Torque Meters

D. Schurmann, I. Jonnsson, and W. Berg
Volkswagenwerk AG, Germany, SAE Paper No 800400, 20 pp, 16 figs, 9 refs

Key Words: Calib...ing, Measuring instruments, Dynamometers, Wheels, Torque

A general calibration method for chassis dynamometers is an important prerequisite for obtaining comparable emissions - and fuel economy test results with reasonable confidence.

80-1671

Development of a Truck Wheel Force Transducer

C A Lysdale and R R Hegmon

Maritime Dynamics, Inc., SAE Paper No. 800247, 12 pp, 13 figs

Key Words: Measuring instruments, Transducers, Trucks, Dynamic tests

A wheel force transducer has been developed for measurement of 3-axis wheel loads on large trucks under dynamic test conditions. Alternate truck tire sizes can be used in either single or dual wheel configurations, and the sensor can be mounted in driven, nondriven, or front (steering) wheel locations. Preliminary calibration data and functional test results are presented for the developmental unit.

80-1672

An Optical Vibration Transducer

R L Bedore

San Diego State Univ., ISA Trans., 19 (1), pp 65-68 (1980) 6 figs, 3 refs

Key Words: Measuring instruments, Transducers, Optical measuring instruments

A problem that frequently arises with experimental vibrations is the need to make relative motion measurements between two moving objects. Past solutions to this problem have used two accelerometers, or similar transducers and the signals have been subtracted and double-integrated to find relative displacements. Capacitative pickups and photographic techniques have also been used. An optical vibration transducer consisting of a "grain of wheat" bulb and a selenium photocell is described in this paper.

80-1673

Advances in Interferometric Signal Analysis

S A Eselun and E G Wolff

Aerospace Corp., ISA Trans., 19 (1), pp 59-64 (1980) 6 figs, 7 refs

Key Words: Measuring instruments, Interferometers

Developments in phase modulation and related signal processing were applied to an automatic, real-time system for monitoring two-beam interference patterns.

80-1674

Enhancement of Laser Pulse Contrast Ratios Via Transient Response of Narrow Band Resonant Interferometers

R.A. Fisher and B. Feldman

Dept. of Energy, Washington, D.C., PAT-APPL-942 227, 7 pp (Sept 14, 1978)

Key Words: Measuring instruments, Interferometers, Transient response

The present invention utilizes the distinction between the narrow bandwidth unwanted fed-through background signal and the broad-band short duration desired signal. In one embodiment, a resonantly tuned Fabry-Perot interferometer will act as a pulse duration discriminator because it will transmit the undesired feed-through while reflecting the desired signal with little modification.

80-1675

Coherent Modulation Applied to Ultrasonic Measurement Systems

D J Redding

Control and Instrumentation, 12 (2), pp 43-45 (Feb 1980)

Key Words: Measurement techniques, Acoustic measurement

Inertialess sensing, provided by resonant vibration, is discussed and a way of updating current sonic techniques is described.

80-1676

Seismic Apparatus for Discrimination Between Track-Type Vehicles and Wheel-Type Vehicles

R P Barnes, Jr and G F Fellows

Dept. of the Army, Washington, D.C., PATENT-4 158 832, 6 pp (June 1979)

Key Words: Seismometers, Measuring instruments, Ground vehicles, Ground vibration

A seismic apparatus is described which is capable of converting the vibrations creeted by a passing vehicle into output pulses having voltage levels indicative of the character of the suspension system of the passing vehicle.

80-1677

Progress on a Mathematical Inversion Technique for Nondestructive Evaluation

N. Bleistein and J.K. Cohen
Denver Applied Analytics, Denver, CO 80222, Wave Motion, 2 (1), pp 75-81 (Jan 1980) 2 figs, 1 table, 17 refs

Key Words: Testing techniques, Nondestructive tests, Optical methods, Wave diffraction, Crack detection

A major objective of research in the area of quantitative nondestructive evaluation is to develop a technique for generating images of flaws inside the titanium "trailer hitch" samples from pulse-echo or back-scatter data. The mathematical basis of the method used for generating these images is called the physical optics far field inverse scattering (POFFIS) identity.

80-1678

The Estimation of Signal Parameters from Disturbed Measuring Systems (Das Schatzen von Signalparametern aus gestorten Messystemen)

H. Kronmüller and G. Jost
Institut f. Prozessmesstechnik und Prozessleittechnik, Universitat (TH) Karlsruhe, Hertzstr. 16/Bau 40, 7500 Karlsruhe, Techn. Messen ATM, 1 (47), pp 15-19 (Jan 1980) 2 figs, 5 refs
(In German)

Key Words: Measurement techniques

The output signal of a measuring system is determined - besides the input signal - by the surge characteristic of the system, by the initial conditions and by noise. The authors investigated which parameters of the input signal are to be calculated from the output signal. Furthermore exogeneous and autoregressive linear models for the signal parameters are developed and are estimated by the "least square" method. The achievable results are described by examples and special problems of the models are discussed.

80-1679

Light Motor Vehicle Noise Levels at Close-in Distances

G.R. Hruska and K.C. Williams
U.S. Environmental Protection Agency, Region V Noise Program, Chicago, IL, S/V, Sound Vib., 14 (2), pp 10-14 (Feb 1980) 4 figs, 2 tables, 4 refs

Key Words: Traffic noise, Motor vehicle noise, Noise measurement, Regulations

Procedures for the determination of motor vehicle noise level limits at distances relatively close to the vehicle, required for enforcing urban ordinances, are presented. The study also details the results of noise measurements made at 12½ feet from the centerline of travel on 8307 light motor vehicles accelerating from rest or near rest.

80-1680

Measuring Technique as a Part of Information Techniques (Die Messtechnik als Teilgebiet der Informationstechnik)

E.-G. Woschni
Sektion Informationstechnik, Technische Hochschule, Reichenhainer Str. 70, DDR 9010 Karl-Marx-Stadt, Techn. Messen ATM, 1 (47), pp 7-14 (Jan 1980) 5 figs, 21 refs
(In German)

Key Words: Measurement techniques, Error analysis

Many measurement problems can be solved by the application of signal-, system- and information-theory. Typical dynamic errors for measurement-systems are drawn up. Curve-distortions as blurred corners, oblique edges, inclinations of straight lines of the real functions (inclined roof) or oscillations caused by the measurement device can be obtained. The classification of systematic errors enables to prevent errors and select suitable measurement devices.

80-1681

New Measuring System of Impact Force - Development and Application to the High Speed Blanking Test

N. Yanagihara and H. Saito

Dept. of Mech. Engrg., Tamagawa Univ., Machida, Tokyo, Japan, Bull. JSME, 23 (175), pp 140-144 (Jan 1980) 11 figs, 1 table, 2 refs

Key Words: Measurement techniques, Impact tests

A new impact force measuring system is proposed, in which the impact force acting on the end of the bar can be estimated from the measured stresses at two suitable points on the bar, and without any restriction of its time range. Using this system, the blanking force in the high speed blanking test is measured, confirming that the measuring system is effective.

80-1682

An Experimental Investigation of the Parabolic Reflector as a Nearfield Calibration Device for Underwater Sound Transducers

M.J. McKemie and C.M. McKinney

Appl. Res. Labs., The Univ. of Texas at Austin, P.O. Box 8029, Austin, TX 78712, J. Acoust. Soc. Amer., 67 (2), pp 523-529 (Feb 1980) 12 figs, 19 refs

Key Words: Calibrating, Measuring instruments, Sound transducers, Underwater sound

Results are presented on an experimental investigation on the use of thin metal parabolic reflectors to form underwater quasiplane wave regions in the nearfield of the reflector. This quasiplane wave volume is then used to calibrate underwater sound transducers in terms of directivity and sensitivity. Experiments were conducted with reflectors ranging from 45 to 122 cm in diameter at frequencies from 30 to 300 kHz. Test transducers, typically half the size of the reflectors, were calibrated both in the nearfield of the reflector and in the farfield (using conventional techniques) and the results were compared. It was found that for the major lobe there was excellent agreement and that the levels of the minor lobes were in acceptable agreement but that the fine detail of the minor lobe structure differed for the two types of measurements.

DYNAMIC TESTS

(Also see No. 1547)

80-1683

Laboratory Tests for Dynamic Ice-Structure Interaction

M.P. Maattanen

Oulu Univ., Finland, 17 pp (Sept 20, 1979)
AD-A076 213/8

Key Words: Test facilities, Interaction: ice-structure, Model testing

The capabilities of the CRREL test basin to simulate dynamic ice-structure interaction with scale model tests cover the whole range of structures in question. For bottom-founded structure simulation, a test pile was designed so that its stiffness, natural frequencies and modes and damping could be varied. The ice movement against the pile was arranged to have constant acceleration in order to excite different modes with different ice velocities.

80-1684

Determination in Ground Facilities of Aerodynamic Stability Parameters of Aircraft

M. Scherer

AGARD, Neuilly-Sur-Seine, France, Rept. No. AGARD-AG-242; ISBN-92-835-2106-4, 69 pp (Sept 1979)
N80-12102

Key Words: Aircraft, Aerodynamic characteristics, Test facilities

The present state of experimental ground facilities for determining the aerodynamic stability parameters of aircraft was deduced from the proceedings of the AGARD/FDP and FMP meetings of the last four years. A critical study of the experimental methods for analyzing unsteady aerodynamic phenomena brings to light the insufficiencies of pressent-day methods and means, especially as regards information necessary for the correct implementation of flight simulators in case of non-linear behavior (separation, shock wave). Suggestions are presented on the possible orientations of research for filling these gaps.

80-1685

Flight Flutter Testing

G. Haidl and M. Steininger

Messerschmitt Boelkow Blohm G.m.b.H., Munich, West Germany, In: Von Karman Inst. for Fluid Dyn. Aeroelastic Problems in Aircraft Design, 41 pp (1979)
N80-12012

Key Words: Testing techniques, Flutter, Aircraft, Digital techniques

The excitation methods applied to flight flutter testing are described. Examples of excitation by frequency sweep, pseudo random, harmonic oscillation and control feedback technique are given and their effectiveness and adaption to digital processing is discussed. Experience with generating aerodynamic forces by control surfaces or additional vanes is presented. The digital analysis of flight flutter test data is evaluated. Recommendations for selection of analysis parameters and how to avoid errors due to digital processing are given. Errors and effects of digital blockwise computation and analysis procedures like block overlapping, windowing, averaging or curve fitting are demonstrated.

80-1686

Wind Tunnel Flutter Investigations

O. Sensburg
Messerschmitt Boelkow-Blohm G.m.b.H., Munich, West Germany, In: Von Karman Inst. for Fluid Dyn. Aeroelastic Problems in Aircraft Design, 59 pp (1979)
N80-12011

Key Words: Wind tunnel tests, Testing techniques, Flutter

Wind tunnel investigations with rigid and dynamically scaled models are examined. An assessment of the influence of parameter variations on flutter speed such as geometry changes, stiffness changes, and external store mass properties is presented. The measurement of unsteady aerodynamic forces with direct pressure transducers or tubes is discussed. Buffet investigations on rigid models are reported.

80-1687

Preliminary Investigations of Design Philosophies and Features Applicable to Large Magnetic Suspension and Balance Systems

C.P. Britcher
Dept. of Aeronautics and Astronautics, Southampton Univ., UK, Rept. No. NASA CR-162433, 35 pp (Nov 1979)
N80-11104

Key Words: Test facilities, Aircraft, Wind tunnel tests, Magnetic suspension techniques

The technology which is required to allow the principles of magnetic suspension and balance systems (MSBS) to be applied to the high Reynolds number transonic testing of aircraft models is examined. A test facility is presented as comprising a pressurized transonic cryogenic wind tunnel, with the MSBS providing full six degree of freedom control. The electro-magnets which are superconducting and fed from quiet, bipolar power supplies are examined. A model control system having some self-adaptive characteristics is discussed.

80-1688

Laboratory Simulation of Steady Tornadic Wind Loads on Structures

M.C. Jischke and B.D. Light
School of Aerospace, Mechanical and Nuclear Engrg., Oklahoma Univ., Norman OK, NUREG/CR-1183, 128 pp (Dec 1979)

Key Words: Test facilities, Wind induced excitation, Simulation

Using a modified tornado simulator, the interaction of tornadic flowfields with structures has been examined empirically. Measurements with and without swirl have been made of the pressure on the surface of a cylindrical model and a rectangular model placed in the simulator. Results are presented for the surface pressure coefficient and the total force moments coefficients for imposed swirl angles of 0 degrees and 45 degrees, with the models placed at three locations within the simulator.

80-1689

Testing Machines for Springs and Structural Components (Prüfmaschinen fur Federn und Bauteile)

G. Wanders
Ackerweg 1, 4240 Emmerich, Automobiltech. Z., 82 (1), pp 23-26 (Jan 1980) 2 figs
(In German)

Key Words: Elastomers, Test equipment and instrumentation, Springs, Fatigue tests, Computer-aided techniques

Machines for dynamic and static testing of tension, compression, and bending of springs, rubber-metal-elements and other resilient rubber and synthetic components are described. A high degree of automation is achieved by adding relevant mechanical, instrumental, and electrical equipment as well as the "on-line" operation with a process computer.

80-1690

Development of a Flat Surface Tire Testing Machine

W.J. Langer and G.R. Potts

MTS Systems Corp., SAE Paper No. 800245, 12 pp, 12 figs, 3 refs

Key Words: Testing equipment and instrumentation, Tires, Truck tires

A low speed continuous belt, flat surface tire testing machine, developed to perform force and moment tests on automotive and light truck tires, is described.

80-1691

A Test Fixture for Measuring Dynamic Hysteretic Energy Loss in Tire Materials

Y.K. Doshi and L.E. Wickliffe

General Motors Res. Labs., Warren, MI, SAE Paper No. 800180, 12 pp, 10 figs, 2 tables, 1 ref

Key Words: Test equipment and instrumentation, Tires, Energy dissipation, Hysteretic damping

A new hysteretic materials test system (HYMATS) has been developed to study energy loss in tire materials. The test facility is designed to subject a tire material specimen to a series of loading profiles. The signals for the displacement and the force experienced by the test specimen are monitored and recorded for further analysis.

80-1692

A Test Machine for the Determination of Tire Energy Dissipation over Transient Driving Cycles

G.F. Hayhoe and G.B. Bucek

Pennsylvania State Univ., SAE Paper No. 800178, 12 pp, 6 figs

Key Words: Test equipment and instrumentation, Tires, Energy dissipation

A flat belt tire test machine is described which was designed to measure tire energy dissipation under conditions simulating a vehicle being driven over a sequence of EPA driving cycles.

80-1693

Field Shock and Vibration Test of Vehicles

Army Test and Evaluation Command, Aberdeen Proving Ground, MD, Rept. No. TOP-2-2-808, 13 pp (Sept 1979)
AD-A075 732/8

Key Words: Testing techniques, Test equipment and instrumentation, Ground vehicles, Shock tests, Vibration tests

A method is provided for evaluating shock and vibration characteristics of vehicles during operation over selected test courses. Describes procedures for measuring structural response and response of components, equipment, cargo, and personnel positions. Describes instrumentation and courses, and provides guidelines for determining points at which three standardized levels of human exposure are reached. Applicable to wheeled and tracked vehicles.

80-1694

Investigations on Unsteady Pressure Distribution Measurements in Rotating Systems

K. Kienappel

Inst. fuer Aeroelastik, European Space Agency, Paris, France, Rept. No. ESA-TT-503-REV, DLR-FB-77-43, 49 pp (Jan 1979)
N80-13059

Key Words: Rotating structures, Wind tunnel tests, Testing techniques

The theoretical basic requirements for measuring unsteady periodical pressure distributions in a rotating system are discussed. An experimental test set-up to investigate the problems of the measurement technology is described. First results of this experiment made in a 3 m wind tunnel are presented and discussed.

80-1695

Analysis and Synthesis of Operational Loads

J.H. Argyris, W. Aicher, and H.J. Ertelt

Royal Aircraft Establishment, Farnborough, UK, Rept. No. RAE LIB TRANS-2008, BR70163, 85 pp (May 1979), Engl. transl. of "Analyse und Synthese von Betriebsbelastungen," Isd Rept. 193 Univ. of Stuttgart (1976)
N80-11504

Key Words: Testing techniques, Fatigue tests

A method for the analysis of the operational loads on light structures is investigated. The representation of the specified

theoretical value, in servohydraulic loading devices, in the form of a Markov matrix of the transition probabilities, is the method examined. The suitability of the method for the analysis and synthesis of operational loads is discussed. The advantages of data reduction and plotting over previous methods for the control of fatigue tests are described and the accuracy of the method in dynamic loading in tests is reported. An analysis and synthesis of an operational load is presented.

80-1696

Dynamic Response of Damaged Angleplied Fiber Composites

C.C. Chamis, J.H. Sinclair, and R.F. Lark

NASA, Lewis Res. Ctr., Cleveland, OH, Rept. No. NASA-TM-79281; E-182, 17 pp (1979)

N80-11145

Key Words: Testing techniques, Composite structures, Layered materials, Fiber composites, Natural frequencies, Damping values

The effects of low level damage induced by monotonic load, cyclic load and/or residual stresses on the vibration frequencies and damping factors of fiber composite angleplied laminates were investigated. Two different composite systems were studied - low modulus fiber and ultra high modulus fiber composites. The results obtained show that the frequencies and damping factors of angleplied laminates made from low modulus fiber composites are sensitive to low level damage while those made from ultra high modulus composites are not. Vibration tests may not be sufficiently sensitive to assess concentrated local damage in angleplied laminates. Dynamic response determined from low-velocity impact coupled with the Fast Fourier Transform and packaged in a minicomputer can be a convenient procedure for assessing low-level damage.

SCALING AND MODELING

(Also see No. 1513)

80-1697

Multiple Shaker Production Testing, Part I

Noise and Vib. Control, 11 (1), pp 12-15 (Jan 1980) 5 figs

Key Words: Testing techniques, Simulation, Spacecraft simulation, Environmental simulation

Digital control of a space environmental simulation on a production multi-station basis, in light of available hardware with a view toward maximum utilization of new and existing facilities is investigated. Since the primary concern is vibration-type environment and, more specifically, the control of this environment, this article concerns itself basically with two aspects of the simulation. The first aspect is the type of vibration to be simulated; that is, random, periodic, or a combination. The second aspect is whether vibration is the only environment to be induced, or if there will be a combined environment.

DIAGNOSTICS

(Also see No. 1726)

80-1698

Statistical Diagnostics Aircraft Engines

Y.V. Kozhevnikov

Allerton Press, Inc., New York, NY, In: Its Soviet Aeron., 21 (2), pp 20-25 (1978), Engl. transl. from Izv. Vyssh. Ucheb. Zaved. Aviats. Tekh., USSR, 21 (2), pp 30-35 (1978), For primary document, see N80-11002, Avail: Allerton Press, Inc., 150 Fifth Ave., New York, NY 10011

Key Words: Engines, Aircraft engines, Diagnostic techniques, Statistical analysis

The linear formulation of the statistical problem for engine parametric diagnostics is examined in a discrete system of steady-state aircraft engine operating regimes.

80-1699

Machinery Vibration Analysis as a Planning Tool for Ships in a Five-Year Maintenance Life-Cycle

M.J. Schwaebe

Naval Engr. J., 92 (1), pp 51-61 (Feb 1980) 9 figs, 5 tables, 7 refs

Key Words: Diagnostic techniques, Machinery vibration, Ships

Machinery vibration analysis as a preoverhaul test is described. Vibration acceptance criteria are discussed, and test results with different criteria are examined. Vibration analysis predictions are compared with material condition findings. Finally, maintenance planning practices with machinery vibration analysis are reviewed.

80-1700

On-Board Acoustic Emission Monitoring of Fiberglass Boom Aerial Lift Trucks

J.W. McElroy

Philadelphia Electric Co., SAE Paper No. 800070, 12 pp, 8 figs, 4 tables

Key Words: Booms (equipment), Fiberglass, Failure analysis, Diagnostic techniques, Acoustic emission

A new technique of assuring the integrity of fiberglass booms on aerial lift trucks is presented in this paper. The research described in this paper is a comprehensive study into the phenomena of boom failures. The critical event degrading the integrity of the boom was found to be damage loads. The paper defines damage loads and discusses the necessity to have the ability to detect and alarm the damage load condition.

ANALYSIS AND DESIGN

ANALYTICAL METHODS

(Also see Nos. 1604, 1617, 1628, 1640, 1647, 1650, 1677)

80-1701

The Graphical Presentation of Noise for Dynamic Analysis

R.A. Heron and J.M.L. Hughes

BHRA Fluid Engineering, Noise and Vib. Control, 11 (1), pp 17-25 (Jan 1980) 5 figs, 3 refs

Key Words: Graphic methods, Fluid-induced excitation, Noise generation, Frequency domain method

The formulation of a dynamic analysis system, based on a D.E.C. PDP 11/40 mini-computer, is described. It is used for the analysis of a variety of dynamic disturbances generated and transmitted by fluid power components.

80-1702

Modal Analysis of Aircraft Structures

H. Foersching

Deutsche Forschungs- und Versuchsanstalt f. Luft- und Raumfahrt, Goettingen, West Germany, In: Von Karman Inst. for Fluid Dyn. Aeroelast. Problems in Aircraft Design, 26 pp (1979)

N80-12003

Key Words: Modal analysis, Aircraft, Substructuring methods, Perturbation theory

The physical and analytical relations of the modal approach, in terms of natural modes and generalized coordinates, for the analytical treatment of dynamic aeroelastic problems of aircraft are demonstrated. Two modal techniques are derived based on the generalized equations of motion of the elastic structure. These are a modal substructure coupling technique, and a modal perturbation method.

80-1703

Analysis of the Steady Motions of Complex Rotating Systems

J.W. Greene

Lawrence Livermore Lab., Univ. of California, Livermore, CA 94550, Intl. J. Engr. Sci., 18 (2), pp 305-324 (1980) 7 figs, 25 refs

Key Words: Periodic response, Rotating structures, Digital techniques

This paper reports on a practical computational framework for analyzing the steady motions of complex rotating systems.

80-1704

Efficient Solution of Modal Equations with Arbitrary Loadings

L.R. Saunders and A.G. Collings

Dept. of Civil Engrg., Univ. of Auckland, Auckland, New Zealand, Eng. Struct., 2 (1), pp 35-48 (Jan 1980) 9 figs, 3 tables, 15 refs

Key Words: Wind-induced excitation, Seismic excitation, Modal analysis

This paper is concerned with the dynamic response of a linear structural system when subjected to such time varying loadings as wind, waves and earthquakes. They may be computed by the modal analysis techniques described herein.

80-1705

Averaging and Chaotic Motions in Forced Oscillations

P.J. Holmes

Dept. of Theoretical and Appl. Mechanics, Cornell Univ., Ithaca, NY 14853, SIAM J. Appl. Math., 38 (1), pp 65-80 (Feb 1980) 7 figs, 17 refs

Key Words: Forced vibration

The averaging theorem of Krylov-Bogoliubov, which allows one to establish the local existence of periodic orbits in certain forced oscillation problems is reviewed.

MODELING TECHNIQUES

(Also see Nos. 1484, 1485, 1503, 1641, 1642, 1646, 1649)

80-1706

Nonlocal, Continuum Models of Large Engineering Structures

J. Holnicki-Szulc and C. Rogula

Polish Academy of Sciences, Inst. of Fundamental Technological Research, Arch. Mech., 31 (6), pp 793-802 (1979) 3 figs, 12 refs

Key Words: Mathematical models, Continuum mechanics

The aim of this paper is to analyze the possibilities of modeling large engineering structures by nonlocal continua. An example of rod structure is discussed in some detail. The discrete description of the structure is known and can be made use of to estimate the accuracy of the results obtained by using individual continuum models. The integral and gradient nonlocal models of the discrete structure have been constructed. The modeling maps and the associated ways of determining the forces in the rods are discussed.

80-1707

MVMA-2D AirBag/Steering Assembly Simulation Model

D.C. Chou, A. Lev, and D.M. Lenardon

Ford Motor Co., SAE Paper No. 800298, 16 pp, 16 figs, 2 tables, 8 refs

Key Words: Mathematical models, Collision research (automotive), Air bags (safety restraint systems), Safety restraint systems, Energy absorption, Steering gear

The described simulation model can mathematically simulate the kinematics of a dummy when restrained by any one of various occupant restraint systems using submodels such as the belt model, the air bag model and the energy absorbing steering assembly model.

80-1708

Practical Aspects of the Calculation of Structural Vibrations

J.P. Brevan

Avions Marcel Dassault, Saint-Cloud, France, In: Von Karman Inst. for Fluid Dyn. Aeroelastic Problems in Aircraft Design, 60 pp (1979)
N80-12007

Key Words: Finite element technique, Dynamic structural analysis, Aircraft

The computation of the vibration modes of structures with finite element models, which leads to large sparse generalized eigen problems, is presented. The basic tools such as sparse matrix factorization are described. A review of the methods for eigensolutions is given. Two methods currently in use, the Lanczos method and the subspace iteration method, are examined. A dynamic substructuring method is presented. Practical results for the model of a complete aircraft are given.

80-1709

Modal Representation and Transfer Function of Linear Dissipative Structures

R. Dat

Office National d'Etudes et de Recherches Aerospatiales, Leclerc, France, In: Von Karman Inst. for Fluid Dyn. Aeroelastic Problems in Aircraft Design, 20 pp (1979)
N80-12005

Key Words: Mathematical models, Modal analysis

The methods used for modeling structures with their normal modes or their natural damped modes are presented. The principle of the classical modal representation is reviewed and the analytic formulation of the transfer functions is obtained as a superposition of natural damped modes. Vibration testing methods based on this formulation are presented. The determination of the structural dynamic characteristics with only one excitation point or only one point of measurement using the vibration testing methods is discussed.

80-1710

On the Use of Finite Element Method on Some Acoustical Problems

L. Cederfelt

Dept. of Building Acoustics, Lund Inst. of Tech., Sweden, Rept. No. D4-1979; ISBN-91-540-3009-9, 95 pp (1979)

N80-11875

Key Words: Finite element technique, Sound attenuation, Ducts

The finite element method application on some acoustical problems is discussed in order to show the possibilities of the method. A brief description of the element formulation for air and beam elements is given and the technique of how to take boundary conditions into consideration and how internal losses are regarded is considered. The coupled beam-air system solution is made by iteration between two equation systems, one for the air and one for the beam elements. Applications such as sound attenuation of a right angle bend, a lined duct and an expansion chamber are described. The finite element method is also discussed in terms of costs and limitations. The method has its power for small geometries or low frequencies, that is, when analytical methods are usually weak. The more complex the geometry of a studied problem is, the more powerful the finite element method seems to be.

80-1711

Quasi-Eulerian Finite Element Formulation for Fluid-Structure Interaction

T. Belytschko, J.M. Kennedy, and D.F. Schoeberle

Dept. of Civil Engrg., Northwestern Univ., Evanston, IL, J. Pressure Vessel Tech., Trans. ASME, 102 (1), pp 62-69 (Feb 1980) 13 figs, 19 refs

Key Words: Interaction: structure-fluid, Finite element technique

A quasi-Eulerian formulation is developed for fluid-structure interaction analysis in which the fluid nodes are allowed to move independent of the material thus facilitating the treatment of problems with large structural motions.

80-1712

Dynamic Finite Element Analysis of Cracked Bodies

J.L. Glazik, Jr.

Reactor Analysis and Safety Div., Argonne National Lab., Argonne, IL 60439, J. Pressure Vessel Tech., Trans. ASME, 102 (1), pp 2-7 (Feb 1980) 10 figs, 16 refs

Key Words: Finite element technique, Impact response (mechanical), Cracked media

Application of the finite element method to problems involving finite cracked bodies subjected to impact loadings is discussed. Mass matrices for a particularly simple, well-established singular element have been developed and applied to the problem of a centrally cracked strip whose ends are loaded by a step tensile stress. The results agree extremely well with those obtained by using a higher order singular element. Results are also presented for this problem employing an equally coarse finite element mesh with no singular element at all, and again good agreement is demonstrated.

NONLINEAR ANALYSIS

80-1713

A Coupled System for Subharmonics of any Order

F.T. El-Mokadem, O.A. Seriki, and R.W. Newcomb

Satellite Business Systems, McLean, VA 22102, J. Acoust. Soc. Amer., 67 (2), pp 477-483 (Feb 1980) 3 figs, 9 refs

Key Words: Nonlinear theories, Subharmonic oscillations

A set of two coupled differential equations with square law nonlinearities is shown to have dominant and stable subharmonic solutions. Mathematical expressions characterizing the subharmonic solutions and their regions of stability are obtained. It is further shown that under appropriate choice of system parameters a resulting system described through these coupled differential equations possesses an exact stable subharmonic of any real order. From this, a design theory is obtained for a system which yields an arbitrary dominant subharmonic. The theory is also directly applicable to the creation of arbitrary stable harmonics.

NUMERICAL METHODS

(See No. 1644)

STATISTICAL METHODS

(Also see Nos. 1572, 1589)

80-1714

Statistical Energy Analysis Response Prediction Methods for Structural Systems

R.F. Davis
McDonnell-Douglas Astronautics Co., Huntington Beach, CA, Rept. No. NASA-CR-161334; MDC-G8150, 107 pp (Oct 1979)
N80-11506

Key Words: Statistical energy methods, Spacecraft

The results of an effort to document methods for accomplishing response predictions for commonly encountered aerospace structural configurations is presented. Application of these methods to specified aerospace structure to provide sample analyses is included. An applications manual, with the structural analyses appended as example problems is given. Comparisons of the response predictions with measured data are provided for three of the example problems.

80-1715
Statistical Identification Techniques for Linear and Nonlinear Dynamic Systems
D.B. Wilson
Ph.D. Thesis, Queen's Univ. at Kingston, Canada (1979)

Key Words: Statistical analysis, Linear systems, Nonlinear systems

This study has considered the identifications of parsimonious models for linear and nonlinear noise corrupted dynamic systems. Statistical identification techniques were developed which use normal open loop operating data. The methods were tested on data from simulated and real dynamic systems.

80-1716
Nonstationary Narrow-Band Response and First-Passage Probability
S. Krenk
Riso National Lab., DK 4000 Roskilde, Denmark, J. Appl. Mech., Trans. ASME, 46 (4), pp 919-924 (Dec 1979) 6 figs, 23 refs

Key Words: Linear systems, Oscillators, Stochastic processes

The notion of a non-stationary narrow-band stochastic process is introduced without reference to a frequency spectrum, and the joint distribution function of two consecutive maxima is approximated by use of an envelope. Based on these definitions the first passage problem is treated as a Markov point process. The theory is applied to the response of a linear oscillator excited by a stationary process from t=0, and a simple algebraic relation between the non-stationary and stationary correlation functions of the response is derived.

PARAMETER IDENTIFICATION

80-1717
Estimation and Identification for Modeling Dynamic Systems
J.M. Mendel
Dept. of Electrical Engrg., Univ. of Southern California, Los Angeles, CA, Rept. No. AFOSR-TR-79-1043, 7 pp (Sept 1979)
AD-A075 059/6

Key Words: Parameter identification techniques, Wave propagation, Layered materials

This study is aimed at state estimation and parameter identification for a new class of models, causal functional equations, which describe wave propagation in layered media systems. These models are applicable to diverse areas, such as reflection seismology, transmission lines, speech processing, optical thin coatings and EM problems.

80-1718
Estimation of Parameters in Dynamic Systems
B.C. Wang
Ph.D. Thesis, Univ. of Toronto, Canada (1979)

Key Words: Parameter identification techniques

A modification of the Gauss-Newton method for parameter identification of dynamic systems is proposed.

80-1719
New Methods for Ground Tests of Aeronautical Structures
G. Piazzoli
Office National d'Etudes et de Recherches Aerospatiales, Leclerc, France, In: Von Karman Inst. for

Fluid Dyn. Aeroelastic Problems in Aircraft Design, 22 pp (1979)
N80-12006
(In French)

Key Words: System identification techniques, Aircraft

The dynamical identification of structures by classical method, based on the distribution of synchronous multiexcitations appropriate for each modal resonance, is discussed. The inaccuracies of the method when it is applied to complex systems, such as aeronautical structures, are described. Two methods are described. The first method consists in resolving the eigenvalues equations of a complex power matrix. The second method is based on the research of a set of forces which isolate one mode and cancel all others. The data acquisition and processing techniques of the ground tests are described.

DESIGN TECHNIQUES

(See No. 1545)

COMPUTER PROGRAMS

(Also see Nos. 1629, 1666)

80-1720

Modal Interpolation Program, L215 (INTERP). Volume I: Engineering and Usage

R I Kroll and M Y Hirayama
Boeing Commercial Airplane Co., Seattle, WA, Rept. No NASA-CR-2847, D6-44456-V-1, 121 pp (Oct 1979)
N79-32164

Key Words: Computer programs, Modal analysis

The usage of the Modal Interpolation Program L215 (INTERP) is described. The program uses modal data to form sets of arrays containing interpolation coefficients. The interpolation arrays can then be used to determine displacements at various aerodynamic surface and surface slopes that are parallel and perpendicular to the freestream direction. Five different interpolation methods are available. A description of the data manipulation and the interpolation methods is presented.

80-1721

Analytical Investigation of the Landing Dynamics of a Large Airplane with a Load-Control System in the Main Landing Gear

J.R. McGehee and H D. Carden
NASA, Langley Res. Ctr., Hampton, VA, Rept. No NASA-TP-1555, L 13250, 85 pp (Dec 1979)
N80-13025

Key Words: Computer programs, Aircraft, Landing gear, Landing, Impact shock

The results of an evaluation of an active load-control landing gear computer program (ACOLAG) for predicting the landing dynamics of airplanes with passive and active main gears are presented. ACOLAG was used in an analytical investigation of the landing dynamics of a large airplane with both passive and active main gears.

80-1722

General Aviation Airplane Structural Crashworthiness Programmer's Manual. Revision

W L LaBarge
Lockheed-California Co., Burbank, CA, Rept. No LR-23683-REV, FAA-RD-78-120-REV, 180 pp (June 1979)
AD-A075 737/7

Key Words: Computer programs, Manuals and handbooks, Crashworthiness, Aircraft, Crash research (aircraft)

This programmer's manual is one of a series of operational documents for program KRASH. In this manual, pertinent information is supplied which will facilitate bringing the program to an operational status on the user's computer system. This manual has been established in such a manner that it can be updated as more data becomes available. The subject material contained within each section can be expanded or revised, as necessary, without affecting the other sections. Each section contains its own numbering system which facilitates the task of updating the document.

80-1723

General Aviation Airplane Structural Crashworthiness User's Manual. Volume II - Input-Output Techniques and Applications. Revision

M A Gamon, G Wittlin, and W L LaBarge
Lockheed-California Co., Burbank, CA, Rept. No LR-28307-VOL-2, FAA/RD-77/189-V2-REV, 25[illegible] pp (Sept 1979)
AD-A075 949/8

Key Words: Computer programs, Manuals and handbooks, Crashworthiness, Aircraft, Crash research (aircraft)

Program KRASH has several features which can be used effectively to evaluate crashworthiness capability of vehicles during the initial stages of a design. Conceptually the program is designed to define the general behavior of structure and to provide data which can be utilized to assess chances of occupant survivability during a severe crash environment. While KRASH currently contains one measure of injury potential (Dynamic Response Index, DRI), the data obtained from KRASH are more useful as input to more complex seat-occupant-restraint system models. Since the program utilizes simplified and approximate representations of structure, it best can be described as a preliminary design tool.

80-1724
Random Harmonic Analysis Program, L221 (TEV-156). Volume I: Engineering and Usage
R.D. Miller and M.L. Graham
Boeing Commercial Airplane Co., Seattle, WA, Rept. No. NASA-CR 2857, D6-44466, 158 pp (Oct 1979)
N80-12058

Key Words: Computer programs, Periodic excitation, Harmonic analysis, Aircraft, Aerodynamic characteristics, Turbulence

A digital computer program capable of calculating steady state solutions for linear second order differential equations due to sinusoidal forcing functions is described. The field of application of the program, the analysis of airplane response and loads due to continuous random air turbulence, is discussed. Optional capabilities including frequency dependent input matrices, feedback damping, gradual gust penetration, multiple excitation forcing functions, and a static elastic solution are described. Program usage and a description of the analysis used are presented.

80-1725
Methods for the On-Line-Optimization of the Steady-State-Behavior of Nonlinear Processes with Slow Dynamics
W. Bamberger
Kernforschungszentrum Karlsruhe G.m.b.H., Germany, 183 pp (Aug 1978)
KFK PDV 159
(In German)

Key Words: Computer programs, Periodic response, Optimization

Various methods for the on-line optimization of the steady-state behavior of slow dynamic processes in a short time are first tested with several test processes, simulated by analog computer, then with a pilot process. For the practical test, a FORTRAN program package called OLIOPT was developed for process computers. The on-line optimization in a short time needs a nonlinear dynamic process model which is updated to predict the static behavior during the transient state of the process. By this model the gradients of the performance index (i.e. maximum efficiency or throughput) derived from the process inputs can be computed and inserted in the optimization algorithm.

80-1726
DYNEST1 - A Revised Dynamic Estimator Calculation Program
D.W. Freeman and J.V. Candy
Lawrence Livermore Lab., California Univ., Livermore, CA, Rept. No. UCRL-52721, 94 pp (Nov 1979)
NUREG/CR 0963

Key Words: Computer programs, Diagnostic techniques, Computer aided techniques

This report is a user's guide for the DYNEST1 computer code which is a program developed at Lawrence Livermore Laboratory to calculate state estimates of a (nonlinear or linear) dynamic system from noisy measurement data. The estimates, their corresponding errors, and diagnostic data are presented primarily in graphical form, but numeric output data are also generated.

GENERAL TOPICS

CONFERENCE PROCEEDINGS

80-1727
The Development and Application of Silent Circular Saw Blades (Entwicklung und Anwendung von geräuscharmen Kreissägeblattern)

VDI-3, 122 (3), pp 87-99 (Feb 1980)
(In German)

Key Words: Saws, Machine tools, Noise reduction

The recent developments in silent circular saws, investigated at various institutes, were presented at a joint meeting of the Institute for Manufacturing Technology and Machine Tools (Institut für Fertigungstechnik und Spanende Wekzeuforschung) and the Institute of Machine Tool Research (Institut für Werkzeugforschung), Sept 1979 in Remscheid. In this article the topics are summarized by the original authors under the following subtitles: The Dynamic Behavior of Disk Shaped Machine Tools, by H.K. Tönshoff; The Meaning of Residual Stresses in Circular Saw Blades, by H. Huber; Noise Reduction of Circular Saws in Alloy Industry, by R. Westphal; Noise Reduction of Ferrous Metal Circular Saws in Rolling Mills, by H. Fritz; The Effect of Tooth Geometry on the Noise of Wood Cutting Circular Saws, by U.V. Münz; Noise Reduction of Wood Cutting Circular Saws by Means of a Composite Action System (Verbundsysteme), by E. Salje, U. Bartsch, and J. Plester; and Noise Separation in the Separation of Stones, by A. Scherger.

TUTORIALS AND REVIEWS

(Also see No. 1733)

80-1728

Fan Noise

T.W. Kanis

Industrial Air, Inc., Amelia, OH, Plant Engr., pp 229-230 (Mar 6, 1980) 1 fig, 1 table

Key Words: Fans, Noise generation, Noise reduction

This article discusses basic terminology, sound ratings, and controlling fan noise.

80-1729

Ground Run-Up Noise Control Facilities for Civil Aircraft - A Survey

D. Braslau

Braslau (David) Associates, Inc., Minneapolis, MN, Rept. No. FAA RD 79 17, 123 pp (Jan 30, 1979)
AD A075 348/3

Availability: Microfilm copies only

Key Words: Reviews, Aircraft noise, Noise barriers

This survey of existing ground run-up suppressors and barriers for civil aircraft includes a review of acoustical, aerodynamical, and mechanical effects associated with facilities in the United States, Europe, and Japan. Evaluations were made of each suppressor based upon published and unpublished reports; and supplemented where necessary by direct questionnaires to the operators, designers, and users of the facilities. Acoustical data where available have been compiled for near and far field points at all directions from aircraft heading. Aerodynamic and mechanical effects on airframe and engine performance during run-up have been identified in terms of exhaust gas reingestion, engine or airframe damage, or restrictions on facility operation. The potential for standards development is discussed with respect to available information with recommendations for additional studies needed before such standards could be promulgated. Summary tables are included in the text for ease in comparison of data type and availability. Data sheets for each facility are included in an appendix.

80-1730

A Handbook of Sound and Vibration Parameters

Electric Boat Div., General Dynamics, Groton, CT, Rept. No. U443-78-072, 210 pp (Sept 18, 1978)
AD-A071 837/9GA

Key Words: Manuals and handbooks, Interaction: solid-fluid, Sound generation, Vibration generation

The contents of this handbook include mechanical vibrating systems, basic acoustics, room acoustics, sound, fluid-solid interactions, parameters of sonar performance, frequency analyses and standard graphs, conversion factors and tabulated values, and bibliography.

80-1731

Vibration of Periodic Structures

G. SenGupta

Boeing Commercial Airplane Co., P.O. Box 3707, Seattle, WA 98124, Shock Vib. Dig., 12 (3), pp 17-31 (Mar 1980) 12 figs, 58 refs

Key Words: Reviews, Periodic structures, Structural members

Many practical engineering structures can be regarded as periodic; that is, they consist of many basic periodic units. Aircraft fuselages, ship hulls, tall multi-storied buildings, periodically supported pipes, composite materials, and heat

exchanger tube banks in a nuclear reactor are examples. Application of periodic structure theory simplifies analysis of dynamic responses of such structures and reduces computer costs. This paper presents an overview of some recent applications of periodic structure theory.

80-1732

Shock Response Spectrum and Maximax Response

Y. Matsuzaki
National Aerospace Lab., Jindaiji, Chofu, Tokyo, Japan, Shock Vib. Dig., 12 (3), pp 11-15 (Mar 1980) 19 refs

Key Words: Reviews, Shock response spectra, Maximax response

This is a review of recent literature on the shock response spectrum and the greatest maximum, or maximax response of structures subjected to shock loads.

80-1733

Turbomachine Blade Vibration

J.S. Rao
Indian Inst. of Tech., New Delhi 110029, Shock Vib. Dig., 12 (2), pp 19-26 (Feb 1980) 90 refs

Key Words: Reviews, Blades, Turbomachinery blades, Vibration response, Vibration damping, Testing techniques

This article reviews the literature on blade excitation forces, vibration of blades with large aspect ratio and small aspect ratio, blade group vibration, blade damping and response, and experimental methods.

80-1734

Vibromotors

K.M. Ragulskis
LTSR, 233000 Kaunas, Mick...iaus g-ve 11, Vibrotechnika, Shock Vib. Dig., 12 (2), pp 27-30 (Feb 1980) 33 refs

Key Words: Vibrators (machinery), Reciprocating engines, Rotors (machine elements), Reviews

Devices that convert oscillations into reciprocating, rotary, or complex multi-dimensional motion of a driven link are employed as actuators. The development of new designs and the mechanisms of transformation of high-frequency oscillations have made these devices very popular. Some of the publications on vibration converters, in particular, vibromotors, are reviewed in this article.

80-1735

Eigenvalue Methods for Vibration Analysis

A. Jennings
Queen's Univ., Belfast BT7 1NN, Northern Ireland, Shock Vib. Dig., 12 (2), pp 3-16 (Feb 1980) 2 figs, 146 refs

Key Words: Reviews, Eigenvalue problems

This article reviews methods for solving dynamic equations to determine characteristic response. In particular numerical methods for eigensolution are considered, as is their relationship to the analysis of both undamped and damped systems.

80-1736

Means for the Reduction of Noise Transmitted from Subways to Nearby Buildings

E.E. Ungar and L.G. Kurzweil
Bolt Beranek and Newman, Inc., 50 Moulton St., Cambridge, MA 02138, Shock Vib. Dig., 12 (1), pp 5-12 (Jan 1980) 2 figs, 31 refs

Key Words: Reviews, Rail transportation, Railroad trains, Traffic noise, Noise reduction, Buildings

A brief overview is presented of how noise and vibration generated by passing subway trains reach buildings near subway tunnels. Various means for reducing the ground-transmitted noise and vibration are described, their effectiveness is discussed, and specific needs for further research are indicated.

80-1737

Some Transient Problems of Submerged Elasto-Plastic Structures

D. Krajcinovic
Dept. of Materials Engrg., Univ. of Illinois at Chicago Circle, 60680, Shock Vib. Dig., 12 (1), pp 15-19 (Jan 1980) 36 refs

Key Words: Reviews, Submerged structures, Interaction: structure-fluid, Transient excitation, Elastoplastic properties

The paper reviews some basic problems in dealing with submerged structures deforming plastically when subjected to transient loads. The paper also lists some of the available literature on the title problem.

80-1738
Recent Advances in Helicopter Vibration Control
G.T.S. Done
Dept. of Mech. Engrg., The City Univ., Northampton Square, London EC1V 0HB, UK, Shock Vib. Dig., 12 (1), pp 21-36 (Jan 1980) 3 figs, 36 refs

Key Words: Reviews, Helicopter vibration effects, Vibration control

This review describes advances that have been made in the past three years in the control of forced vibration excitation and response of helicopter airframes. Methods and hardware for vibration control, including isolators, absorbers, direct rotor control, and structural modification are considered.

80-1739
Dynamic Testing - How Far We've Come, How Much Further to Go
A.J. Curtis
Hughes Aircraft Co., Culver City, CA 90230, Shock Vib. Dig., 12 (3), pp 3-8 (Mar 1980) 2 figs, 3 tables

Key Words: Reviews, Dynamic tests

This paper provides an overview of dynamic test techniques and extrapolates the route of past technical developments to predict likely future capabilities. In parallel, shortcomings of these techniques vis-a-vis desired capabilities are examined to detect where improvements are most needed and/or can most readily be achieved. Particular attention is devoted, on the one hand, to the future of the most sophisticated techniques of digital control, and on the other hand, to the simplicity desired for screening tests.

CRITERIA, STANDARDS, AND SPECIFICATIONS
(Also see Nos. 1490, 1679)

80-1740
Noise Levels and Flight Profiles of Eight Helicopters Using Proposed International Certification Procedures
J.S. Newman and E.J. Rickley
Office of Environment and Energy, Federal Aviation Admn., Washington, D.C., Rept. No. FAA-AEE-79-03, 298 pp (Mar 1979)
AD-A074 532/3

Key Words: Helicopter noise, Standards

This document reports the findings of helicopter noise tests conducted at the FAA National Aviation Facility Experimental Center. The tests were conducted with the objectives of determining the feasibility of a takeoff procedure for helicopter noise certification; establishing a data base of helicopter noise levels to be used in defining noise standards, and acquiring helicopter acoustical spectral data for a variety of acoustical angles for use in the FAA Integrated Noise Model.

BIBLIOGRAPHIES
(Also see No. 1497)

80-1741
Passive Restraints
L. Flynn
Technical Services Div., National Highway Traffic Safety Administration, Washington, D.C., Rept. No. DOT-HS-805 044, SB-37, 190 pp (Sept 1979)
PB80-111834

Key Words: Bibliographies, Collision research (automotive), Safety restraint systems

The bibliography represents literature on the development and use of passive restraints in motor vehicles.

80-1742
Automobile Safety: Seat Belts (A Bibliography with Abstracts)
M.E. Young
National Technical Information Service, Springfield, VA, 229 pp (Dec 1979)
PB80-801558

Key Words: Bibliographies, Collision research (automotive), Safety restraint systems, Seat belts, Automobile seat belts

Articles on the development and use of passive safety restraint systems in motor vehicles are abstracted in the bibliography.

80-1743
Noise Control for Motor Vehicles (Citations from the Engineering Index Data Base)
D.M. Cavagnaro
National Technical Information Service, Springfield, VA, 199 pp (Oct 1979)
PB80-800295

Key Words: Bibliographies, Motor vehicles, Noise reduction, Trucks, Automobiles, Buses, Motorcycles

The cited reports from a worldwide literature survey cover noise control through tire, muffler, and engine design. The types of vehicles studied include automobiles, trucks, buses, and motorcycles.

80-1744
Noise Control for Motor Vehicles (Citations from the NTIS Data Base)
D.M. Cavagnaro
National Technical Information Service, Springfield, VA, 99 pp (Oct 1979)
PB80-800287

Key Words: Bibliographies, Noise reduction, Motor vehicles, Automobiles, Buses, Motorcycles, Trucks

These citations cover different methods to control noise generated by motor vehicles. Although most of the studies concern trucks, automobiles, buses, and motorcycles are also covered.

80-1745
Wind Effects. Part I. Buildings and Bridges (Citations from the Engineering Index Data Base)
G.E. Habercom, Jr.
National Technical Information Service, Springfield, VA, 319 pp (Dec 1979)
PB80-801988

Key Words: Bibliographies, Buildings, Bridges, Wind-induced excitation

Dynamic structural response of buildings and bridges to wind pressure and gust loads are investigated in these reports gathered from a worldwide literature survey.

80-1746
Wind Effects. Part I. Buildings and Bridges (Citations from NTIS Data Base)
G.E. Habercom, Jr.
National Technical Information Service, Springfield, VA, 206 pp (Dec 1979)
PB80-801962

Key Words: Bibliographies, Buildings, Bridges, Wind-induced excitation

Dynamic structural responses of buildings and bridges to wind pressure and gust loads are investigated in these Government-sponsored research reports. Residential buildings, skyscrapers, and bridge structures exposed to winds are studied.

USEFUL APPLICATIONS

(Also see No. 1734)

80-1747
Good Vibes Reduce Stresses in Metal Parts
D.R. Dreger
Mach. Des., 50 (13), pp 100-103 (June 8, 1978) 4 figs

Key Words: Vibratory techniques

The vibratory method of relieving stresses in castings and weldments described herein not only does the job of thermal stress relieving but also does it faster, cheaper, and more conveniently.

AUTHOR INDEX

CALENDAR

JULY 1980

7-11 Recent Advances in Structural Dynamics Symp., [Institute of Sound and Vibration Research] University of Southampton, Southampton, S09 5NH, UK *(Mrs. O.G. Hyde, ISVR Conference Secretary, The University, Southampton, S09 5NH, UK - Tel (0703) 559122, Ext. 2310)*

8-10 1980 National Conference on Environmental Engineering [ASCE] New York, NY *(ASCE Hq.)*

AUGUST 1980

18-21 International Lubrication Conference [ASME - ASLE] San Francisco, CA *(ASME Hq.)*

SEPTEMBER 1980

2-4 International Conference on Vibrations in Rotating Machinery [IMechE] Cambridge, England *(Mr. A.J. Tugwell, Institution of Mechanical Engineers, 1 Birdcage Walk, London SW1H 9JJ, UK)*

8-11 Off-Highway Meeting and Exposition [SAE] MECCA, Milwaukee, WI *(SAE Hq.)*

14-16 ASME Petroleum Division Conference and Workshop [ASME] Denver, CO *(ASME Hq.)*

28-Oct 1 Design Engineering Technical Conference [ASME] Beverly Hills, CA *(ASME Hq.)*

OCTOBER 1980

Stapp Car Crash Conference [SAE] Detroit, MI *(SAE Hq.)*

6-8 Computational Methods in Nonlinear Structural and Solid Mechanics [George Washington University & NASA Langley Research Center] Washington, D.C. *(Professor A.K. Noor, The George Washington University, NASA Langley Research Center, MS246, Hampton, VA 23665 - (804) 827-2897)*

14-15 Textile Engineering Technical Conference [ASME] Atlanta, GA *(ASME Hq.)*

21-23 51st Shock and Vibration Symposium [Shock and Vibration Information Center, Washington, D.C.] San Diego, CA *(Henry C. Pusey, Director, SVIC, Naval Research Lab., Code 5804, Washington, D.C. 20375)*

27-31 ASCE Annual Convention & Exposition [ASCE] Hollywood, FL *(ASCE Hq.)*

28-30 Eastern Design Engineering Show [ASME] New York, NY *(ASME Hq.)*

NOVEMBER 1980

16-21 ASME Winter Annual Meeting [ASME] Chicago, IL *(ASME Hq.)*

18-21 Acoustical Society of America, Fall Meeting [ASA] Los Angeles, CA *(ASA Hq.)*

DECEMBER 1980

Aerospace Meeting [SAE] San Diego, CA *(SAE Hq.)*

8-10 INTER-NOISE 80 [International Institute of Noise Control Engineering] Miami, FL *(INTER-NOISE 80, P.O. Box 3469, Arlington Branch, Poughkeepsie, NY 12603)*

9-11 Western Design Engineering Show [ASME] Anaheim, CA *(ASME Hq.)*

MARCH 1981

8-12 26th International Gas Turbine Conference and Exhibit [ASME] Houston, TX *(ASME Hq.)*

21-Apr 1 Lubrication Symposium [ASME] San Francisco, CA *(ASME Hq.)*

JUNE 1981

1-4 Design Engineering Conference and Show [ASME] Chicago, IL *(ASME Hq.)*

22-24 Applied Mechanics Conference [ASME] Boulder, CO *(ASME Hq.)*

SEPTEMBER 1981

20-23 Design Engineering Technical Conference [ASME] Hartford, CT *(ASME Hq.)*

OCTOBER 1981

4-7 International Lubrication Conference [illegible] *(ASME Hq.)*

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CALENDAR ACRONYM DEFINITIONS AND ADDRESSES OF SOCIETY HEADQUARTERS

AFIPS: American Federation of Information Processing Societies
210 Summit Ave., Montvale, NJ 07645

AGMA: American Gear Manufacturers Association
1330 Mass. Ave., N.W.
Washington, D.C.

AHS: American Helicopter Society
1325 18 St. N.W.
Washington, D.C. 20036

AIAA: American Institute of Aeronautics and Astronautics, 1290 Sixth Ave.
New York, NY 10019

AIChE: American Institute of Chemical Engineers
345 E. 47th St.
New York, NY 10017

AREA: American Railway Engineering Association
59 E. Van Buren St.
Chicago, IL 60605

ARPA: Advanced Research Projects Agency

ASA: Acoustical Society of America
335 E. 45th St.
New York, NY 10017

ASCE: American Society of Civil Engineers
345 E. 45th St.
New York, NY 10017

ASME: American Society of Mechanical Engineers
345 E. 45th St.
New York, NY 10017

ASNT: American Society for Nondestructive Testing
914 Chicago Ave.
Evanston, IL 60202

ASQC: American Society for Quality Control
161 W. Wisconsin Ave.
Milwaukee, WI 53203

ASTM: American Society for Testing and Materials
1916 Race St.
Philadelphia, PA 19103

CCCAM: Chairman, c/o Dept. ME, Univ. Toronto,
Toronto 5, Ontario, Canada

ICF: International Congress on Fracture
Tohoku Univ.
Sendai, Japan

IEEE: Institute of Electrical and Electronics Engineers
345 E. 47th St.
New York, NY 10017

IES: Institute of Environmental Sciences
940 E. Northwest Highway
Mt. Prospect, IL 60056

IFToMM: International Federation for Theory of Machines and Mechanisms
U.S. Council for TMM
c/o Univ. Mass., Dept. ME
Amherst, MA 01002

INCE: Institute of Noise Control Engineering
P.O. Box 3206, Arlington Branch
Poughkeepsie, NY 12603

ISA: Instrument Society of America
400 Stanwix St.
Pittsburgh, PA 15222

ONR: Office of Naval Research
Code 40084, Dept. Navy
Arlington, VA 22217

SAE: Society of Automotive Engineers
400 Commonwealth Drive
Warrendale, PA 15096

SEE: Society of Environmental Engineers
6 Conduit St.
London W1R 9TG, UK

SESA: Society for Experimental Stress Analysis
21 Bridge Sq.
Westport, CT 06880

SNAME: Society of Naval Architects and Marine Engineers
74 Trinity Pl.
New York, NY 10006

SPE: Society of Petroleum Engineers
6200 N. Central Expressway
Dallas, TX 75206

SVIC: Shock and Vibration Information Center
Naval Research Lab., Code 5804
Washington, D.C. 20375

URSI-USNC: International Union of Radio Science
U.S. National Committee
c/o MIT Lincoln Lab
Lexington, MA 02173